Application No.:	A.18-07-xxx
Exhibit No.:	SCE-01
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SOUTHERN CALIFORNIA EDISON®

An *EDISON INTERNATIONAL*® Company

(U 338-E)

Testimony of Southern California Edison Company in Support of its Application For Approval of Electric Vehicle Charging at Schools, State Parks and Beaches (AB 1082 & 1083).

Before the

Public Utilities Commission of the State of California

Rosemead, California

July 30, 2018

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I.

INTRODUCTION

Southern California Edison Company ("SCE") submits the following testimony in support of its Application for Approval of Electric Vehicle Charging at Schools, State Parks and Beaches (the "Application") in accordance with Assembly Bills 1082 ("AB 1082") and 1083 ("AB 1083") (collectively, the "AB 1082 and 1083 Pilots").[1] The bills authorize SCE, and the other California investor-owned utilities, to file applications requesting California Public Utilities Commission ("CPUC") approval of pilots to support the installation of electric vehicle charging stations at school facilities and other educational facilities (AB 1082[2]) and State parks and beaches (AB 1083[3]) by July 30, 2018. The CPUC must review, modify if appropriate, and decide whether to approve the applications by December 31, 2018.

This Application continues the implementation of a transportation electrification pathway for light-duty vehicles that SCE launched in 2014 with its Charge Ready and Market Education Programs, which were developed to support California's policies to reduce greenhouse gas ("GHG") and air pollutant emissions and which also help meet the State's zero-emission vehicle ("ZEV") goals. This Application requests a total of $19.77 million (2018$) for two, two-year pilots that will support and accelerate light-duty EV adoption, in line with California's goals of substantially reducing GHG emissions and criteria pollutants by 2030. Such emission and criteria pollutant reductions are critical to

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1 Assembly Bill (AB) 1082 (Chapter 637, Statutes of 2017) and AB 1083 (Chapter 638, Statutes of 2017) became law in October 2017.

2 AB 1082 authorizes each of the electric utilities to file an application to propose a pilot for the installation of electric vehicle charging stations at school facilities and other educational institutions. This could provide support for electrified school buses. The participating school or educational facility shall have the authority to establish guidelines for the use of charging stations installed through the pilot.

3 AB 1083 authorizes each of the electric utilities to file an application to propose a pilot for the installation of electric vehicle charging stations at State parks and beaches. Additionally, AB 1083 requires utilities to consult with the Department of Parks and Recreation (Parks), CPUC, California Energy Commission (CEC), and California Air Resources Board (ARB) if they file an application.

southern California's communities, several of which are severely impacted by harmful emissions and located in the only two air basins in the country that are in extreme ozone non-attainment.

Key elements of SCE's AB 1082 and 1083 Pilots include:

- Supporting and accelerating the adoption of light-duty EVs on a trajectory consistent with SCE's *Clean Power and Electrification Pathway*, which identifies a need for 7 million light-duty EVs by 2030 to reach California's GHG and air quality goals,[4] and at the same time consistent with being able to at least meet the Governor's call for 5 million EVs by 2030;[5]
- Installing make-ready infrastructure at approximately 40 K-12 school facilities[6] and providing approximately 250 charging ports for light-duty EVs pursuant to AB 1082;[7]
    - Complementing the infrastructure proposal with a proposed marketing, education, and outreach ("ME&O") campaign targeted at teachers, students, and parents to influence early adoption of EVs;
- Providing infrastructure State parks and beaches ("Parks") pursuant to AB 1083, including: (1) EV charging for Park fleet and employee vehicles and (2) EV charging for Park visitors;
    - Installing, owning and operating charging stations (Level 2 and, in some sites, Direct Current ("DC") Fast Chargers ("DCFC")) at Parks, with site design to vary based on the needs of the particular Park and the constraints of the site. SCE

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4 *See* Appendix A – SCE Clean Power and Electrification Pathway White Paper.

5 Executive Order B-48-18 (Jan. 26, 2018), *available at* https://www.gov.ca.gov/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/.

6 As defined by Cal. Pub. Util. Code § 740.13(a) (3),"School facility" means owned or leased improved real property used for the purpose of the private or public education of more than 12 children in kindergarten or any of grades 1 to 12, inclusive, or in any combination thereof, or any other facility of a school district or county office of education where activities described in subdivision (c) are provided, but does not include any private school in which education is conducted primarily in private homes.

7 Many schools were not eligible to participate in the Charge Ready Pilot because they could not meet the minimum parking spot requirements. The AB 1082 Pilot will remove this barrier.

estimates that as many as 120 Level 2 charging ports and 10 DCFC ports could be installed at approximately 27 park locations during the Pilot;[8]

- Targeting the needs of low-income and State-designated disadvantaged communities ("DACs") by prioritizing sites located in or serving residents of DACs as part of the evaluation criteria.

This is a critical time that requires all stakeholders to work toward a rapid and sustained approach to transform the transportation market. Zero-emission vehicles are essential to California's comprehensive climate and air quality plans. By increasing EV adoption, SCE's AB 1082 and 1083 Pilots improve local air quality and reduce GHG emissions broadly.

Table I-1, below, provides a comparison of AB 1082 and AB 1083 Pilot components. Table I-2, below, provides an overview of the AB 1082 Pilot costs. Table I-3 provides an overview of the AB 1083 Pilot costs.

Table I-1
AB 1082 and AB 1083 Pilot Comparison

AB 1082 and AB 1083 Comparison		
	AB1082 – K-12 Schools	**AB1083 – State Parks and Beaches**
Duration	2 years	2 years
Total Cost	$9.89 M	$9.88 M
Scope		
Estimated Sites	40	27
Targeted Level 2 ports	250	120
Targeted DCFC ports	N/A	10
Targeted Portable Devices	N/A	15
Education and Marketing	-Grade-Level Specific Material -Faculty Education Program -EV Economic Education	Broad marketing campaign to support park charging awareness and overcome range anxiety
Vehicle Types Served	Light-duty faculty, staff, student and visitor vehicles (electric buses excluded – eligible in SCE's current medium-/heavy-duty TE program)	Light-duty Park fleet, employee, and visitor vehicles
Charging Station Ownership Model	Customer make-ready with option for SCE to own and operate station or customer own and operate with rebate	SCE ownership with possible 3rd-party operational contract (where applicable)
Cost to site host	EVSE purchase or participation payment and any costs above provided rebates	Electricity for fleets

[8] Site locations depend upon requests made by each participating site. SCE assumed an average port deployment of 4.5 ports per site based on survey data and conversations with Park districts in SCE territory.

Table I-2
AB 1082 Pilot
2018$, not loaded, millions

Capital Expenditures (Millions of Constant Dollars)	2019	2020	2021	Total
Capital				
Infrastructu	$ 0.00	$ 3.60	$ 3.60	$ 7.20
Pilot Labor	$ 0.02	$ 0.11	$ 0.11	$ 0.25
Total Capital	**$ 0.02**	**$ 3.71**	**$ 3.71**	**$ 7.45**
O&M				
Labor	$ 0.17	$ 0.37	$ 0.27	$ 0.80
Station Ownership	$ -	$ 0.14	$ 0.29	$ 0.42
ME&O and Other Non-Labor	$ 0.23	$ 0.69	$ 0.30	$ 1.21
Total O&M	**$ 0.40**	**$ 1.19**	**$ 0.85**	**$ 2.44**
Total Capital & O&M	**$ 0.42**	**$ 4.90**	**$ 4.56**	**$ 9.89**

Table I-3
AB 1083 Pilot
2018$, not loaded, millions

Capital Expenditures (Millions of Constant Dollars)	2019	2020	2021	Total
Capital				
Infrastructure	$ 0.00	$ 3.37	$ 3.37	$ 6.75
Pilot Labor	$ 0.02	$ 0.08	$ 0.08	$ 0.18
Total Capital	**$ 0.02**	**$ 3.45**	**$ 3.45**	**$ 6.93**
O&M				
Labor	$ 0.17	$ 0.35	$ 0.25	$ 0.77
Station Ownership	$ -	$ 0.07	$ 0.14	$ 0.20
ME&O and Other Non-Labor	$ 0.15	$ 0.93	$ 0.92	$ 1.99
Total O&M	**$ 0.31**	**$ 1.34**	**$ 1.30**	**$ 2.96**
Total Capital & O&M	**$ 0.34**	**$ 4.79**	**$ 4.75**	**$ 9.88**

II.

TRANSPORTATION ELECTRIFICATION TRANSFORMATION

SCE has long been a supporter of EV adoption. In recent years, SCE has enabled charging station growth through deployment of "make-ready" infrastructure for EV charging stations. In 2014, SCE filed the Charge Ready and Market Education Program Application ("2014 Application"). In the 2014 Application, SCE began to lay the groundwork for the full-scale deployment of light-duty EV infrastructure and education programs including the Charge Ready Pilot, Charge Ready 2 (which SCE filed on June 26, 2018), and the AB 1082 and 1083 Pilots (proposed in this Application). With the continuing market need for more EV charging infrastructure, the AB 1082 and 1083 Pilots support the move to widescale deployment of EV infrastructure in support of the State's critical GHG and air quality goals.[9] In the AB 1082 and 1083 Pilots, SCE will deploy electric infrastructure to support light-duty EV charging at schools and State parks and beaches throughout SCE's service area, consistent with the direction set forth by the California legislature for these Pilots.

A. Transportation Electrification is Crucial to Achieving California's GHG Goals.

Climate change poses serious threats; the effects of climate change, such as sea level rise and longer, more intense heat waves, are already escalating. California has taken ownership, within the context of the broader global community, to align its GHG emissions reductions targets with the Paris Agreement—to limit global warming to well below 2 degrees.[10] California's GHG goals call for a 40 percent reduction in GHG emissions from 1990 levels by 2030 and an 80 percent reduction by 2050.[11] While California reduced its GHG emissions ten percent from their peak in 2004, meeting 2030 requirements and 2050 goals will require California to reduce emissions at more than three times the annual rate achieved between 2004 and 2015. To be successful throughout this three-decade span and

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[9] *See* Section II.D.1.

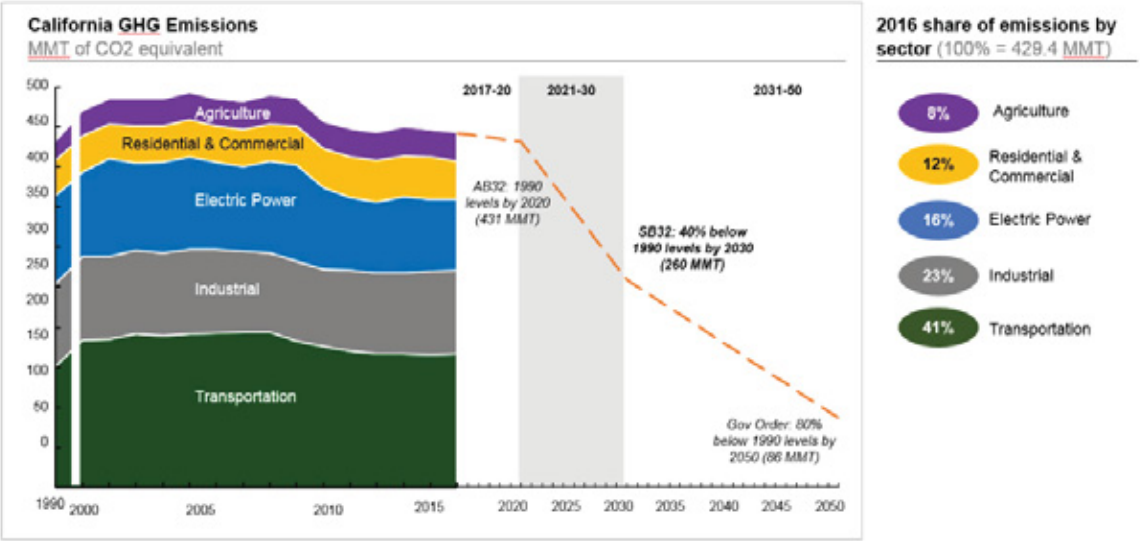
[10] *See* CARB, *California's 2017 Climate Change Scoping Plan* (Nov. 2017), *available at* https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.

[11] Executive Order S-3-05 (2005) established a target of reducing GHG emissions 80 percent below 1990 levels by 2050.

beyond, the State must implement fundamental changes across all economic sectors. No individual sector can achieve the emissions goal alone.

Figure II-1

California's GHG Emissions Goals[12]



In November 2017, SCE released *The Clean Power and Electrification Pathway* white paper, a proposed, integrated approach to achieve California's GHG emissions and air pollution reduction goals by taking action in three key economic sectors: electricity, transportation, and buildings. By 2030, SCE calls for an electric grid supplied by 80 percent carbon-free energy, more than 7 million electric vehicles on California roads, and using electricity to power nearly one-third of space and water heaters in increasingly energy-efficient buildings.[13] Removing any one of these three pillars would make meeting the State's 2030 and 2050 GHG reduction goals exceedingly more costly and would potentially delay meeting the goals established by law. Without significant decarbonization in the transportation sector, the State's 2030 and 2050 GHG reduction goals become impossible.

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[12] *See* CARB, *California Greenhouse Gas Emissions for 2000 to 2016, Trends of Emissions and Other Indicators*, 2018 Edition, *available at* https://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2016/ghg_inventory_trends_00-16.pdf.

[13] *See* Appendix A – SCE Clean Power and Electrification Pathway White Paper.

On June 26, 2018, SCE proposed Charge Ready 2 to accelerate the adoption of light-duty electric vehicles on a trajectory consistent with SCE's identified need of 7 million vehicles. However, as stated in the supporting testimony, the Charge Ready 2 program only addresses one-third of the incremental market need between 2020 and 2023. The infrastructure need is much greater than the current rate of installation. Today's away-from-home port count is 34 to 55 percent below the level needed to adequately support the number of EVs already on the road in 2017.[14,15] Additionally, as stated in the Charge Ready 2 testimony, significant marketing, education and outreach programs need to be deployed to overcome EV awareness barriers.[16] SCE's proposed AB 1082 and 1083 Pilots target specific locations with unique transportation electrification opportunities and learnings.

B. Transportation Electrification is a Key Solution to State Environmental Goals.

2030 is just over 11 years away. The average passenger car life is 11.4 years.[17] From this day forward, every time an internal-combustion engine ("ICE") vehicle is purchased and an EV is not, there is a missed opportunity to reduce emissions from the transportation sector. Prior to 2018, everyone could take comfort that, on average, the newly purchased vehicle would retire prior to 2030. Today, this is not the case. Every vehicle purchased from this day forward will likely still be on the road in 2030. Section 1(c) of AB 1082 and Section 1(c) of AB 1083 acknowledges that "[t]he [S]tate is behind schedule in attaining the Governor's goal that by 2015 all major cities in California will have adequate infrastructure intended to support the goal of 1.5 million zero-emission vehicles by 2025. The 2020 goal

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14 *See* California Energy Commission, California Plug-In Electric Vehicle Infrastructure Projections: 2017-2025, March 2018, pp. 5, *available at* http://docketpublic.energy.ca.gov/PublicDocuments/17-ALT-01/TN222986_20180316T143039_Staff_Report__California_PlugIn_Electric_Vehicle_Infrastructure.pdf. Estimated market need in 2017 for Level 2 destination chargers ranged from 21,502 to 28,702 and DCFC ranged from 2,005 to 5,877 to support 239,328 plug-in electric vehicles. California has 15,492 public charge points, 1,776 of which are DCFC as of April 25, 2018.

15 *See* U.S. Department of Energy, *Alternative Fuels Data Center, Alternative Fueling Station Locator* (accessed April 25, 2018), *available at* https://www.afdc.energy.gov/stations#/analyze.

16 On June 26, 2018, SCE submitted its Application for Approval of its Charge Ready 2 Infrastructure and Market Education Programs ("Charge Ready 2"), continuing the implementation of a transportation electrification pathway that SCE launched in 2014 with its Charge Ready and Market Education Programs.

17 U.S. Department of Transportation, *Average Age of Automobiles and Trucks in Operation in the United States Chart*, *available at* https://www.bts.gov/content/average-age-automobiles-and-trucks-operation-united-states.

of establishing adequate infrastructure to support one million zero-emission vehicles is also behind schedule. More needs to be done to install the electric vehicle charging infrastructure that will support and enable these critical electric vehicle goals." The AB 1083 Pilot will explore a novel approach to deploying charging infrastructure in remote areas. Additionally, the AB 1082 Pilot will increase customer awareness about the benefits of EVs through broad and targeted education programs with a unique emphasis on educating future drivers about the characteristics and benefits of electric vehicles. As recognized by AB 1082 and AB 1083, it is urgent that the State focus on the transition to zero-emission vehicles.

1. Light-duty transportation electrification offers the largest, economical GHG-reduction opportunity.

The electric sector is at the forefront of the fight against climate change in California and today accounts for only 16 percent of the State's GHG emissions. The electric sector reduced its GHG emissions by 40 percent since the height of California's GHG emissions in 2004. In contrast, the transportation sector represents 41 percent of California's GHG emissions, and is the largest GHG-emitting segment in California.[18] Since 2004, the transportation sector has reduced its GHG emissions by only 9 percent. The California Air Resource Board ("CARB") states that the transportation sector will be the largest reduction opportunity in 2030.[19] While internal-combustion engine cars will become more efficient, they will not decarbonize as quickly as the electric sector. Electrification of light-duty vehicles is the only viable option to progress toward carbon-free and petroleum-free transportation goals over the next 11 years.

Additionally, transportation sector GHG reductions are economical. CARB's 2017 scoping plan assigns mobile sources' abatement costs at less than $50 per metric ton in 2030.[20] The cost

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[18] *See* CARB, *California Greenhouse Gas Inventory 2000-2016 – by Economic Sector Categorization* (July 11, 2016), *available at* https://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_sector_sum_2000-16.pdf.

[19] *See* CARB, *2017 Climate Change Scoping Plan* (Nov. 2017), p. 31, *available at* https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.

[20] *Id*., p. 46.

of abatement is significantly less than that of using liquid biofuels to comply with California's low carbon fuel standard ("LCFS") carbon reduction intensity target of 18 percent ($150 per metric ton) and meeting the renewables portfolio standard ("RPS") target of 50 percent ($175 per metric ton).[21]

2. Transportation electrification reduces air pollution.

The federal Clean Air Act requires states to meet certain health-based ozone and particulate matter requirements by 2023 and 2032.[22] The only two air basins in the nation that are in extreme ozone non-attainment are the South Coast Air Basin and the San Joaquin Valley Air Basin; SCE serves communities in both of these basins.[23] Transportation electrification will help the State meet ground-level ozone and particulate emissions reduction requirements.[24]

NOx and reactive organic gases contribute to the formation of harmful particulate matter in the atmosphere; both pollutants also react with sunlight to form smog (ground-level ozone).[25] The transportation sector emits 80 percent of NOx pollution and is the second highest source of PM2.5.[26] While the medium- and heavy-duty vehicle segments represent the majority of NOx and PM2.5 emissions in the on-road mobile category, light-duty vehicles account for one-third of NOx emissions

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21 *Id.*

22 There are deadlines for attainment of several ambient air quality standards for several pollutants, including the 2032 deadline for ground-level ozone (formed by NOx and organic compounds in the atmosphere). Further adopted standards for ground-level ozone will require additional reductions of NOx by 2037. *See* SCAQMD, *Final 2016 Air Quality Management Plan* (March 2017), *available at* http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/final2016aqmp.pdf?sfvrsn=15.

23 *See* CARB, *Mobile Source Strategy* (May 2016), pp. 6-9. This mobile source strategy requires actions to increase the deployment of zero-emission transportation technologies in order to achieve the 2023 and 2031 air quality standards, on-road GHG emission reduction, and toxic air contaminant exposure reduction. *Available at* https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf.

24 *See* SCAQMD, *Final 2016 Air Quality Management Plan* (March 2017), *available at* http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/final2016aqmp.pdf?sfvrsn=15.

25 *See* U.S. Environmental Protection Agency, *Air Pollution Facts and Figures*, *available at* https://www3.epa.gov/airnow/mediakits/ozone/facts.pdf.

26 *See* CARB, *Statewide 2012 Estimated Annual Average Emissions*, *available at* https://www.arb.ca.gov/app/emsinv/2017/emssumcat_query.php?F_YR=2012&F_DIV=-4&F_SEASON=A&SP=SIP105ADJ&F_AREA=CA.

and over 40 percent of PM2.5.[27] Hence, additional transportation electrification of light-duty vehicles will reduce these smog-forming emissions and particulates leading to cleaner air and healthier communities, particularly in disadvantaged communities.

C. Transportation Electrification Provides Additional Customer Benefits

1. Transportation electrification creates downward pressure on rates.

As transportation electrification increases, it has the potential to lower the cost of electric service for electric customers by spreading fixed costs over a larger base of kilowatt hour ("kWh") sales. SCE estimates that electrification of the light-duty market could put downward pressure on rates in the long-term. EVs provide incremental, flexible load to the electric grid. By increasing overall system load, the fixed costs of the system will be spread over more kilowatt hours. Additionally, EV load is flexible and could be managed to reduce total system costs further. The combination of these two facts leads to downward pressure on rates.

2. Transportation electrification could improve integration of renewable generation.

Transportation electrification could also improve integration of renewable generation by using time-of-use ("TOU") rates as an incentive for load management.[28,29] As noted in the Commission's recent decision adopting updated TOU periods proposed by SCE, including shifting the peak period to later in the day and implementing a winter season super-off-peak period during daytime

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[27] Light-duty vehicle subcategories included in calculation: light-duty passenger vehicles, light-duty trucks 1, light-duty trucks 2, light-heavy-duty diesel trucks 1, light-heavy-duty diesel trucks 2, light-heavy-duty gas trucks 1, and light-heavy-duty gas trucks 2. *See* CARB, *Statewide 2012 Estimated Annual Average Emissions*, *available at* https://www.arb.ca.gov/app/emsinv/2017/emssumcat_query.php?F_YR=2012&F_DIV=-4&F_SEASON=A&SP=SIP105ADJ&F_AREA=CA.

[28] The Natural Resources Defense Council's ("NRDC's") report explains how TOU rates for EVs are an important tool to benefit utility customers through improved use of the electric system and integration of renewables. *See* Max Baumhefner & Roland Hwang, *Driving Out Pollution: How Utilities Can Accelerate the Market for Electric Vehicles*, pp. 4-5, 15-16 (June 2016), *available at* https://assets.nrdc.org/sites/default/files/driving-out-pollution-report.pdf?_ga=2.263452876.1775610777.1532557828-2129074617.1532557828.

[29] *See* Environmental Defense Fund, *Time-of-Use Electricity Pricing: Savings When They Matte*r, p. 1, *available at* https://www.edf.org/sites/default/files/ca_tou_fact_sheet_091514.pdf.

hours, "properly defined TOU periods will provide incentives for customer use and development of future generation that better reflects the State's electric grid. This, in turn, should assist in reaching State energy goals by minimizing costs, reducing [GHG] emissions, encouraging conservation, and increasing the supply of electricity at times that best serve the needs of the grid."[30] Additionally, increased transportation electrification creates future opportunity to control vehicle charging at shorter intervals to provide grid benefits through vehicle grid integration.[31]

D. Barriers Continue to Impede EV Adoption.

Over 399,000 EVs are registered in California with 127,000 of those EVs residing in SCE territory.[32] EVs represent 5.4 percent of new vehicle sales in California.[33] While this percentage has consistently increased since 2010, the EV share of new sales needs to grow dramatically through 2030 for California to meet its climate and air quality goals. Barriers continue to impede EV adoption.[34] While the high-level barriers—charging availability, awareness, and affordability—have remained persistent, research is exposing important nuances and a more detailed understanding of these barriers.[35]

In addition to SCE's broader TE portfolio, the AB 1082 and 1083 Pilots will also reduce barriers to EV adoption through deployment of EV charging infrastructure, increasing the availability of charging stations to reduce range anxiety. Specifically, the AB 1083 Pilot will explore a novel approach to deploying charging infrastructure in remote areas. Additionally, the AB 1082 Pilot will increase customer awareness about the benefits of EVs through broad and targeted education programs with a

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30 D.18-07-006, p. 9.

31 *See* National Renewable Energy Laboratory, *EV-Grid Integration (EVGI) Control and System Implementation,* p. 8 (March 2016), *available at* https://www.nrel.gov/docs/fy16osti/65861.pdf.

32 As of April 2018, data from the Electric Power Research Institute ("EPRI") on annual light-duty vehicle sales in California, based on registration data obtained through RL Polk, measured at the county level.

33 *Id*.

34 *See* Zeinab Rezvani, Johan Jansson & Jan Bodin, *Advances in consumer electric vehicle adoption research: A review and research agenda* (Jan. 2015), *available at* https://www.sciencedirect.com/science/article/pii/S1361920914001515.

35 Charles Fleming, *How will I charge my electric vehicle? And where? And how much will it cost?* (Sep. 2016), *available at* http://www.latimes.com/business/autos/la-fi-hy-agenda-ev-charging-20160920-snap-story.html.

unique emphasis on educating future drivers about the characteristics and benefits of electric vehicles. These Pilots are intended to facilitate widespread adoption of light-duty EVs throughout California, in support of the State's climate goals.

1. Charging Availability

In order to increase the light-duty electric vehicle stock nearly 20 times from today's levels to meet the State's ambitious and important GHG and clean air goals, significant and coordinated action is required across multiple fronts to address each of these barriers. Many studies have identified range anxiety as a top barrier to EV adoption, with several facets contributing to the broader sentiment: access to public charging stations, access to home charging and vehicle battery range.[36] An SCE survey found that 69 percent of respondents identified away-from-home charging uncertainty as an important barrier; 66 percent of respondents identified difficulty installing home charging as an important barrier; and 84 percent of respondents identified limited mileage range per charge as an important barrier.[37] Similar results were found in other studies.[38],[39] Within each of these identified sub-barriers, complexities emerge. For example, the number of away-from-home chargers today is 34 to 55 percent

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[36] *See*, *e.g.*, Chris Mooney, "*Range anxiety" is scaring people away from electric cars, but the fear may be overblown* (Aug. 2016), *available at* https://www.washingtonpost.com/news/energy-environment/wp/2016/08/15/range-anxiety-scares-people-away-from-electric-cars-why-the-fear-could-be-overblown/?utm_term=.2f2de7104a53.

[37] Data from SCE, *Electric Vehicle Marketing Survey*, July 2017. 2,597 invitations sent to SCE Customers Plugged In community members, 31 percent response rate (July 19 through July 25, 2017). The survey participants are customers who have volunteered to participate, have online access and can take surveys in English. This demographic tends to skew somewhat towards having more education and higher home ownership than the general public. Nonetheless, the survey results should appropriately represent the relative importance of concerns customers have about purchasing EVs.

[38] *See* Center for Sustainable Energy, *The Clean Vehicle Rebate Project: Summary Documentation of the Electric Vehicle Consumer Survey,* 2013-2015 Edition, pp. 24-26 (June 2017), *available at* https://cleanvehiclerebate.org/sites/default/files/attachments/CVRPConsumerSurvey2013-15Reference.pdf.

[39] *See* Kenneth Kurani et al., *New Car Buyers' Valuation of Zero-Emission Vehicles: California,* pp. 114-119 (March 2016), *available at* https://www.arb.ca.gov/research/apr/past/12-332.pdf.

below the level needed to adequately support the number of EVs already on the road in 2017.[40],[41] Given that the number of EVs on the road continues to increase, California will have an even wider gap to close if away-from-home infrastructure does not significantly increase its installation pace.

2. Lack of Awareness

The lack of general awareness about EVs and their benefits remains a major barrier. In a recent national survey, 54 percent of respondents could not name a single plug-in EV, only 13 percent of respondents reported to have ever been in a plug-in EV, and 59 percent of respondents thought battery electric vehicles were not as good as gasoline vehicles.[42] In a California-specific study, CARB found that 49 percent of respondents were aware of federal EV incentives, but only 32 percent were aware of State incentives.[43] Additionally, customers have multiple misconceptions about the performance and reliability of EVs: many assume that gasoline-powered cars are more reliable than battery electric vehicles even though battery electric vehicles require less maintenance and carry comparable 100,000 mile warranties.[44] Respondents also assume gasoline-powered vehicles are safer than battery electric vehicles (despite the fact that there is no evidence to support this misconception).[45] CARB stated that misunderstanding and lack of knowledge about plug-in hybrid vehicles and battery EVs may be the most

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[40] *See* California Energy Commission, *California Plug-In Electric Vehicle Infrastructure Projections: 2017-2025*, p. 5 (March 2018), *available at* https://www.nrel.gov/docs/fy18osti/70893.pdf. Estimated market need in 2017 for L2 destination chargers ranged from 21,502 to 28,702 to support 239,328 plug-in electric vehicles. California has 15,492 public charge points, 1,776 of which are DCFC as of April 25, 2018.

[41] *See* U.S. Department of Energy, *Alternative Fuels Data Center, Alternative Fueling Station Locator*, *available at* https://www.afdc.energy.gov/stations#/analyze.

[42] *See* Mark Singer, National Renewable Energy Lab, *Consumer Views on Plug-in Electric Vehicles – National Benchmark Report,* p. 11 (Dec. 2016), *available at* https://www.nrel.gov/docs/fy17osti/67107.pdf.

[43] *See* Kenneth Kurani et al., *New Car Buyers' Valuation of Zero-Emission Vehicles: California,* CARB Agreement 12-332, p. 41 (March 2016), *available at* https://www.arb.ca.gov/research/apr/past/12-332.pdf.

[44] *See* U.S. Department of Energy*, Alternative Fuels Data Center* (visited June 2, 2018)*, available at* https://www.afdc.energy.gov/vehicles/electric_maintenance.html.

[45] *Id*.

important finding of its study.[46] Significant actions need to be taken to address this persistent awareness gap.

[46] *See* Kenneth Kurani et al., *New Car Buyers' Valuation of Zero-Emission Vehicles: California,* CARB Agreement 12-332, p. 135 (March 2016), *available at* https://www.arb.ca.gov/research/apr/past/12-332.pdf.

III.

SCE'S AB 1082 AND 1083 PILOTS

SCE's proposed AB 1082 and AB 1083 Pilots contain several features focusing on overcoming barriers to accelerate EV adoption and to help put California on the path to achieving its GHG goals and air quality requirements.

A. AB 1082 Pilot

In SCE's AB 1082 Pilot, SCE plans to install make-ready infrastructure at approximately 40 K-12 school facilities[47] and provide approximately 250 charging ports for light-duty EVs. SCE has chosen to focus its AB 1082 Pilot on K-12 schools to enhance the infrastructure investment with an education and outreach campaign for teachers and students. A second key component of the AB 1082 Pilot is the deployment of an EV education program aimed at empowering teachers to become EV ambassadors in their communities and providing EV-related curriculum-enhancing materials. The AB 1082 education component will increase utilization of the on-campus chargers by spreading awareness and magnify the effects of the pilot by increasing knowledge about EVs in the next generation of drivers.

1. Infrastructure

a) Objectives

The broad objective of the AB 1082 Pilot is to accelerate adoption of EVs in SCE territory as needed to meet the State's GHG and air quality goals. SCE is supporting this objective by deploying approximately 250 much needed charging ports at Level 1 and Level 2 charging stations to serve school facilities as well as implementing an EV education program specifically tailored to meet the needs of K-12 schools.

[47] As defined by Cal. Pub. Util. Code § 740.13(a) (3), a "School facility" means owned or leased improved real property used for the purpose of the private or public education of more than 12 children in kindergarten or any of grades 1 to 12, inclusive, or in any combination thereof, or any other facility of a school district or county office of education where activities described in subdivision (c) are provided, but does not include any private school in which education is conducted primarily in private homes.

b) Description

In SCE's AB 1082 Pilot, SCE plans to install make-ready infrastructure at approximately 40 K-12 school facilities and provide approximately 250 charging ports for light-duty EVs. Similar to SCE's Charge Ready Pilot and Charge Ready 2, a "make-ready" installation comprises both "in-front-of-the-meter" as well as "behind-the-meter" infrastructure. The "in-front-of-the-meter" portion of these installations will include, as needed, a separately-metered circuit together with utility transformer upgrades, service drop, panel, trenching, wiring, conduit, step-down transformers, and other equipment. Additional "behind-the-meter" infrastructure may include, but is not limited to, electrical panels, conduit, and wires as well civil construction work in compliance with various regulations including the California Building Code's accessibility requirements for public and common use, and the Americans with Disabilities Act ("ADA").

For the duration of the two-year AB 1082 Pilot, SCE will also offer all Pilot participants a turnkey option for SCE to own and operate the charging stations at their sites. Under this option, site hosts will be required to meet the contractual needs of the make-ready deployment (e.g., easement), complete relevant participation payment(s) and pay for all electricity charges, but will not be obligated to purchase or maintain charging stations.

In the event that customers choose to own and operate the charging stations on their site, SCE plans to provide a rebate to cover part of the costs of charging equipment that meets SCE's functional and installation requirements in the AB 1082 Pilot. SCE plans to offer a flat rebate to all customers for qualified Level 1 and Level 2 charging stations. The charging station rebate amount will be determined at SCE's discretion, up to 100 percent of the cost of the charging stations and their installation, and updated as needed throughout the Pilot, based on market costs for each charging station type. SCE plans to provide a rebate up to $2,000 per charge port for Level 1 or Level 2 charging stations owned by customers. Rebates will not exceed 100 percent of the total cost of the charging station and installation.

SCE will also offer customers an option to manage and pay for the installation of the customer-side infrastructure and use qualified, State-licensed labor, paid the prevailing wage,[48] for which the utility will provide a rebate of up to 80 percent of the installation costs.[49]

Participating customers will be responsible for procuring, installing and maintaining charging stations in good working order for eight years after the initial installation.[50] Customers will have discretion to replace charging stations with other qualified stations, at their own cost, throughout the duration of the Pilot and beyond. Customers will also be responsible for any charging station and installation costs that exceed available rebates and for all energy costs.

SCE has determined that AB 1082 Pilot-eligible sites are not high-priority locations for DC fast charging and, therefore, DCFC is not an option in this Pilot. During conversations with the California Department of Education, school districts in SCE territory and some interested schools agency personnel and school administrators explained that child safety is a major concern that may prevent public use of charging stations during in-school hours. Additionally, some school representatives explained that their lots were secured after hours and did not allow public access. Therefore, the additional cost of DCFC is not justified due to the limited access allowed to the public not affiliated with the schools and potential low throughput on any installed DCFC stations.

c) Gaps and Customer Charging Needs

In addition to serving a market segment identified by the legislature as important enough to be specifically served, SCE had significant interest from school facilities during its Charge Ready Pilot.[51] Unfortunately, many schools were not eligible to participate in the Charge Ready Pilot

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[48] Cal. Pub. Util. Code § 740.13(f).

[49] SCE modeled the customer-owned infrastructure rebate option after the medium- and heavy-duty program infrastructure rebate designed by the Commission. *See* D.18-05-040, pp. 160-61.

[50] After a school district, county office of education, private school, or other educational institution has participated in the program for eight years, the school district, county office of education, private school, or other educational institution may cease participation in the pilot program and request removal of the charging station by providing 180-day notice to the electrical corporation. Cal. Pub. Util. Code § 740.13(i).

[51] Forty-five schools submitted applications to the Charge Ready Pilot; 10 K-12 schools and 4 colleges/universities are participating with 1 K-12 and 2 colleges/universities on the waitlist.

because they did not meet minimum parking spot requirements. Moreover, limited parking spaces at the school sites for teachers and administrators made it difficult to devote ten parking spaces solely to EV charging. Changes to the AB 1082 Pilot eligibility requirements, compared to those in the Charge Ready Pilot, will allow for a greater number of the nearly 6,000 eligible school facilities to participate in the AB 1082 Pilot. Additionally, schools have a unique approval process; therefore, a dedicated program should be able to better accommodate the need for school board approvals. Due to these design changes, SCE assumes that demand will outstrip funds available for the Pilot.

d) Pilot Fit in SCE's Suite of Programs

The AB 1082 Pilot compliments and expands SCE's commitment to achieve the Governor's goal to establish adequate infrastructure to support California's electric vehicle goals by overcoming two key barriers of charging station availability and low EV awareness. SCE's Pilot specifically targets a key market segment, schools, that is not explicitly targeted through any of its existing infrastructure or education programs. Additionally, the proposed education campaign has not been pursued through other programs and takes a unique, long-term view on overcoming the barrier of general awareness by targeting future generations of vehicle users.

e) Scope and Cost

(1) Customer and Site Eligibility

The AB 1082 Pilot is limited to California K-12 school facilities as defined by § 740.13(a)(3). Participating customers must provide SCE with the rights-of-way across public or private property (as applicable) and obtain any necessary permits satisfactory to SCE unless the customer elects the option to build, own, and operate the customer-side infrastructure. Sites choosing to participate in the Pilot would have authority to establish guidelines for use of the charging stations installed pursuant to the approved Pilot.

Site deployment size will not be constrained by the size of the parking lot, but a minimum of two ports per site will be required to participate in the Pilot. Participating customers must have an Edison SmartConnect® meter or interval data recorder ("IDR") meter dedicated to registering charging site loads. All charging site load must be separately metered from any other load

served at the premises or be measured by another equivalent way to verify charging load acceptable to SCE.

The customer of record (e.g., site host, electric vehicle supply provider ("EVSP")) will be required to take service on one of SCE's time-differentiated rates, but the customer of record will have flexibility to set pricing and parking restrictions for drivers charging at their site.[52] SCE will encourage participating customers to pass SCE's TOU rate through directly to drivers, but participating customers may elect to implement their own pricing plans.[53] Regardless of the customer's billing selection, participating customers will be required to participate in a demand response program. SCE will also require participating customers to report prices charged to drivers. SCE will provide aggregate information to its advisory board quarterly. SCE will work to educate participating customers to ensure that end-use pricing is easy for drivers to understand and provides the opportunity for drivers to access electricity that is less costly than gasoline while meeting the needs of participating customers.[54]

(2) Site Prioritization Criteria

If the Pilot is approved, SCE will prioritize sites that (a) are in high vehicle population areas (e.g. zip code) and therefore are more likely to have higher need for chargers; (b) are within disadvantaged communities; and (c) have access to appropriate electrical infrastructure in order to meet port targets within the approved budget of the Pilot.

(3) Accommodating Future Needs

SCE will work with customers to plan for future site growth and may install hardware with additional capacity (e.g., panels and transformer pads) and infrastructure to accommodate future charging stations (e.g., trenching, conduit, wire) and electrical needs. Having the infrastructure pre-installed will allow the charging stations to be added easily and economically at a later

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[52] *See* Cal. Pub. Util. Code § 740.13(g).

[53] Custom pricing plans allow participating customers to provide EV charging to patron drivers at no cost, or at a rate that would allow them to recover some of the charging infrastructure's operational costs.

[54] Cal Pub. Util. Code § 740.12 (a)(1)(H) states that deploying electric vehicle charging infrastructure should facilitate increased sales of electric vehicles by making charging easily accessible and should provide the opportunity to access electricity as a fuel that is cleaner and less costly than gasoline or other fossil fuels in public and private locations.

date. Customers will be required to provide a commitment to install additional charging stations within a defined time period.

SCE will work with participating customers and electrical contractors to identify appropriate locations within the participating customer's parking lot to deploy charging stations economically (based on factors such as proximity to transformers, length of trenching, available transmission and distribution capacity, and ease of access for EV drivers). SCE representatives will also help identify alternative locations, as needed. SCE may deny a customer's request to participate in the Pilot if the customer and SCE cannot agree upon an installation configuration and location that is reasonably economical, as determined by SCE in its sole discretion.

(4) Qualified Vendors, Products and Services

To promote competition and customer choice, SCE intends to include a broad range of qualified charging station models and network service providers from multiple suppliers as part of the Pilot offering. SCE will issue a Request for Information ("RFI") to technically capable and financially viable third-party suppliers, including qualified Women Minority Disabled Veteran Business Enterprise ("WMDVBE") suppliers, to cover the provision, installation, operation, networking and maintenance of the charging stations. Prospective suppliers will be asked to submit sample models to supply and install qualified charging stations, based on the RFI's requirements. Suppliers will have to demonstrate capabilities to supply qualified stations in appropriate volumes, and to provide maintenance and network-related services (e.g., charging data collection and management), either through the charging station or through a kiosk or gateway.

To qualify for the Pilot, charging station equipment and controls will be evaluated against established standards (e.g., SAE J2836, IEEE 2030) and must comply with technical standards and energy efficiency recommendations (e.g., SAE Standards J1772, J2894, J2847, J3068; Title 20) and be listed by a nationally recognized testing laboratory. If the proposed equipment complies with relevant standards, is listed by a nationally recognized testing laboratory, and is approved by SCE, the charging station would be eligible for the Pilot and receive a rebate. Participating

customers would be responsible for any additional cost above the rebate amount of the charging equipment and its installation.[55]

In addition, all Level 2 EVSE must be demand-response capable (e.g., capable of receiving and executing real-time instructions to reduce and modify end-user pricing of EV charging load) and are encouraged to include additional load management features (e.g., EV charging sequencing or power sharing). EVSE must be controllable by SCE, either directly or through a vendor cloud service (e.g., OpenADR 2.0b), and must have the capabilities for each port to be independently controllable from 0 – 100 percent linear throttling.

Participating customers who elect to own their charging stations will be required to maintain charging station operability and communication functionality for eight years after installation. After eight years, school facilities will be permitted to request removal of the charging stations.[56] Customers will, additionally, be permitted to change or update their charging stations and networking service provider throughout the useful life of the underlying infrastructure at their own cost.

(5) Customer Engagement and Enrollment

SCE will market to potential customers via email and direct interactions with relevant SCE account managers serving school districts in SCE territory, as well as during public presentations delivered to key stakeholders. SCE will also reach out directly to school sites leveraging contact lists and understanding of key barriers gained through the Charge Ready Pilot and help them with their applications. Some of the barriers include difficulty conducting EV adoption surveys during the summer months, difficulty contacting EVSE suppliers, and submission of incomplete proof of purchase documents. All tactics will be informed and optimized by the use of analytics incorporating data from a variety of customer touchpoints including, but not limited to, SCE-owned platforms (e.g.,

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[55] Unless customer has chosen for SCE to own and operate charging stations on their site, and SCE has approved this election.

[56] After a school district, county office of education, private school, or other educational institution has participated in the program for eight years, the school district, county office of education, private school, or other educational institution may cease participation in the pilot program and request removal of the charging station by providing 180-day notice to the electrical corporation. Cal. Pub. Util. Code § 740.13(i).

SCE.com, InsideEdison.com), social media (e.g., LinkedIn, Facebook, Twitter), and SCE operational channels (e.g., customer contact centers).

(6) Demand Response

Demand Response ("DR") is a tool used by utilities to change a customer's electric load so that it can provide benefits to the grid when needed. The grid can be stressed when generation resources are scarce or abundant, or regional or local grid issues exist. For example, midday EV charging may be served mostly by solar energy. However, as the sun rises or sets, natural-gas-fueled generation may be used to balance electrical supply and demand on the grid.[57] This increases GHG emissions and, depending on the wholesale market generation resources available at the time, may also increase electrical wholesale cost.

Various DR strategies can be utilized to minimize these effects. In addition to load reduction, SCE is testing and developing load shifting strategies for the Charge Ready Pilot sites to encourage charging when there is abundant renewable energy. This provides two benefits: (1) better integration of renewable power and (2) reduced GHG and criteria pollutant emissions as a greater mix of renewable energy is used to charge EVs.

To inform future DR programs for EV charging, SCE developed and is executing a Charge Ready DR pilot. All Level 2 EVSE in the Charge Ready Pilot must be DR-compatible and all sites in the Charge Ready Pilot must participate in this DR pilot. During the DR pilot, SCE is testing and developing various types of DR events and issues such as load curtailment, load shifting, and DR messaging; the optimal percentage of load to drop or shift; the best times and event durations to benefit the grid and reduce customer inconvenience; and appropriate incentive amounts to maximize participation. SCE will apply these strategies to the AB 1082 Pilot. Only Level 2 or larger charging stations will be eligible for DR.

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[57] *See* Michael Panfil and James Fine, *Putting Demand Response to Work for California*, Environmental Defense Fund, pp. 5-6 (2015), *available at* https://www.edf.org/sites/default/files/demand-response-california.pdf.

(7) Data Collection and Reporting

In addition to quarterly status reports presented to the TE Advisory Board, SCE proposes to provide a closeout report to the Commission's Energy Division and other interested stakeholders after completion of the Pilot. The proposed report will evaluate data across all Pilot activities, including but not limited to: (i) customer enrollment and participation data; (ii) Pilot process information; (iii) Pilot installation costs; and (iv) customer usage data (e.g., EV usage data, transactions per day). The Advisory Board updates will include information on progress, achievements, and lessons learned.

(8) Cost Components

For the proposed AB 1082 Pilot, SCE incorporated lessons learned from the Charge Ready Pilot to reduce costs. For example:

- Packaged Site Designs: SCE developed threshold site sizes that trigger major equipment size changes. The switchgear and metering panels are a significant cost driver for each site and packaging in various sizes should allow SCE to leverage buying power for multiple panels at once rather than the site-specific, special-order approach used in the Charge Ready Pilot.
- Site Feasibility Reviews: SCE will perform a high-level review of each site prior to engaging a design firm for a formal site assessment, saving on engineering fees for locations that cannot proceed due to site conditions.
- Ability to Use Customer Distribution Facilities: SCE may take a service drop from a customer transformer when there is sufficient existing capacity and SCE deems it to be more economical than creating a stand-alone SCE line extension.
- Streamlined Plan Check Processes and Reduced Fees with Authorities Having Jurisdiction ("AHJs"): SCE intends to

coordinate working sessions with AHJs to reduce the timing and costs associated with permitting and plan checks. Based on the volume of sites across its various programs, SCE hopes to minimize costs and time by leveraging the State's EV mandates to influence AHJ performance and fees.

SCE's cost estimates were developed using actual results realized in the Charge Ready Pilot and a detailed analysis of specific activities completed by each organization contributing to the Charge Ready Pilot implementation.

Capitalized Costs

- Utility-Side Costs – SCE developed utility-side cost estimates using actual costs from sites participating in the Charge Ready Pilot. Two installation examples (fixed meter and service, and line extension meter and service) were developed and scaled to two different deployment scenarios. These costs include labor, materials (transformer, cable, duct) and design and permitting costs up to the SCE meter.
- Customer-Side Costs – SCE developed customer-side cost estimates in consultation with internal subject matter experts and request for proposal ("RFP") responses from external electrical contractors participating in the Charge Ready Pilot. These costs include customer site design (additional costs included for Division of State Architects inspection and soil testing[58]), planning, engineering, construction (including trenching) labor, and materials from the SCE meter to the stub out.

[58] DSA inspection and soil testing is required for State sites. SCE is working with DSA to streamline process and minimize costs where possible.

- Charging Stations – Charging station costs based on average total cost of charging stations procured during the Charge Ready Pilot.
- Contingency – SCE includes a 10 percent contingency[59] in its utility-side and customer-side infrastructure costs.
- Other Capitalized Costs – Other capitalized costs include easement-related expenses, charging equipment testing to verify that charging stations meet requirements of the Pilot, and all capitalized labor.

O&M Costs

- Rebate – SCE plans to provide a rebate up to $2,000 per charge port for Level 1 or Level 2 charging stations owned by customers. Rebates will not exceed 100 percent of the total cost of the charging station and installation.
- Labor – Forecasted labor captures all organizations required to implement the Pilot outside of capitalized labor. Labor estimates were determined by detailing unique implementation activities including, but not limited to, procurement, customer enrollment, infrastructure deployment, management and post-deployment customer support and operations.
- Other Non-Labor – Other non-labor operation and maintenance ("O&M") expenses include preparation of reports and creation of marketing materials.

[59] In D.18-05-040, Ordering Paragraph 32, the Commission approved a 10 percent contingency to establish the budget for standard-review projects.

- Ongoing O&M costs following the two-year Pilot will be captured in subsequent general rate case requests.[60]

Table III-4
AB 1082 Infrastructure Program Budget
2018$, not loaded, millions

Capital Cost	**Year 0**	**Year 1**	**Year 2**	**TOTAL**
Utility-side Costs (make-ready)	-	0.8	0.8	**1.5**
Customer-Site Cost (make-ready)	-	2.4	2.4	**4.7**
Ownership Station Cost (incremental)	-	0.5	0.5	**1.0**
Non-labor (Capital)	0.0	0.0	0.0	**0.0**
Labor (Capital)	0.0	0.1	0.1	**0.2**
TOTAL	**0.0**	**3.7**	**3.7**	**7.4**
Program O&M				
Non-labor (Expense)	-	0.0	-	**0.0**
Labor (Expense)	0.2	0.4	0.3	**0.8**
Ownership and Operation O&M	-	0.1	0.3	**0.4**
TOTAL	**0.2**	**0.5**	**0.6**	**1.2**
Infrastructure Subtotal	**0.2**	**4.2**	**4.3**	**8.7**

f) Disadvantaged Communities

As part of the AB 1082 Pilot implementation, SCE will need to manage and prioritize its queue of approved sites. In addition to forecasted utilization and economic installation costs, a key component will be the prioritization of sites located in DACs to ensure that objectives and associated benefits from the Pilot (e.g., station deployment, education and outreach) are realized in disadvantaged communities. Customers will be queued into the AB 1082 Pilot using a first-come, first-served process. However, DAC sites will be prioritized over non-DAC sites. To help prioritize DAC participation throughout the course of the Pilot, SCE will develop a higher threshold for average port cost to qualify DAC sites, and SCE will conduct directed marketing for potential DAC participants.

[60] This proposal is consistent with the Commission's decision on SCE's medium- and heavy-duty charging infrastructure program. *See* D.18-05-040, p. 125.

g) Partners and Leveraged Funding

California agencies provide important, limited funds for the purchase of EVs. SCE's proposals provide funding for make-ready infrastructure and, in some cases, charging station and infrastructure rebates, which will complement public funding targeting the incremental cost of EVs and support the acceleration of transportation electrification by mitigating cost barriers. SCE will encourage participating customers to apply for available third-party funding. Additionally, SCE will work with other utilities implementing similar pilots to leverage research, materials and funds where appropriate.

h) Duration

As directed by the Assigned Commissioner's Ruling of January 24, 2018, in Rulemaking (R.) 13-11-007 (hereinafter "ACR"), and AB 1082 and 1083, SCE is requesting approval for a two-year pilot.

i) Safety

SCE, along with Pacific Gas and Electric Company ("PG&E") and San Diego Gas & Electric Company ("SDG&E"), participated in review of the draft safety checklist developed for the SB 350 priority-review transportation electrification projects. If and when the Safety Requirement Checklist is finalized, SCE will adhere to those requirements for the 1082 Pilot to the extent feasible.

2. Marketing, Education and Outreach

a) Objectives

The AB 1082 Pilot will test new strategies to educate the next generation of drivers through on-campus events and curriculum-enhancing materials designed to teach the public about EVs and their benefits. These two features of the Pilot will complement SCE's Charge Ready 2 portfolio and help alleviate key barriers to EV adoption—charger availability and awareness.

b) Creative Agencies and Vendors

SCE plans to implement the proposed efforts with a combination of in-house resources, third-party creative agencies and other vendors. When SCE procures these services from third parties, SCE utilizes a consistent set of professional service vendors which support all SCE ME&O

programs. These vendors are awarded contracts based on SCE procurement policies and procedures, including a competitive RFP process, subject to SCE's WMDVBE requirements.

c) Data Collection and Reporting

The Customer Education program will be monitored to understand its impact and track whether it meets its objectives. Webpage metrics may include click through rate, bounce rate, unique visitors and repeat visitors. Pre- and post-surveys will be conducted to understand whether the students, faculty and others in the targeted areas (1) are aware of EVs in general, (2) are more aware of EV charging availability in the targeted schools than those in non-target areas, and (3) have different perceptions of EVs or a different willingness to buy an EV than those in non-target areas.

d) Customer Education Program

SCE proposes a comprehensive ME&O initiative to tackle key adoption barriers and address customer needs within K-12 schools. Many of these activities align with programs SCE is already delivering, making them a natural role for the utility. The Pilot's objective is to help the EV market resolve significant barriers broadly, such as availability of charging stations and EV awareness, and, specifically, enabling more charging station deployment.

In response to these barriers and customer needs, SCE proposes three discrete, related efforts to develop awareness about EVs and the benefits of fueling from the electric grid, and to assist faculty and their students and parents as they consider adopting EVs:

1. **Grade-Level Specific Material** to increase awareness of EVs, their societal benefits, the benefits of fueling from the grid, the economics of EV ownership, and repair and maintenance skills;
2. **Faculty Education Program** leveraging calls to action, signage, new web content, and the launch of an educator EV proponent network; and
3. **EV Economic Education** with promotion of online self-service tools to help educators estimate the total cost of EV ownership, lower-income resource support and information, and promotion of alternatives to new EV purchases, including previously-owned EVs, leases, and ride-sharing.

The K-12 Campus EV Awareness Campaign will primarily target education influencers, administration, faculty, students, and parents. In addition, it will include specific engagement of DAC customers who face additional socioeconomic barriers and live or work with a concentrated amount of air pollution, largely caused by fossil-fueled vehicles.[61] ME&O will familiarize administration, faculty, students, and parents with EVs, EV charging, and available EV incentives and rebates that make EVs more affordable, including special State incentives available to customers in DACs.

Below, SCE outlines specific information for each effort including: descriptions of the effort, how the effort addresses different customer needs, and the effort's objectives. There are certain implementation aspects that will be the same across all ME&O activities, which are described beginning in Section III.C.2.

e) Grade Level-Specific Outreach

(1) Description

In order to increase EV awareness in K-12 schools, SCE will develop material targeted towards students in specific grade levels. These materials will also target their parents, who are making EV purchasing decisions today. Channels may include video, print, web, and experiential outreach. Examples include animated videos, educational webpages, and outreach through a mobile EV Education Classroom.

(a) Targeted Content

SCE plans to reach K-12 students with key messages to create general awareness through a mix of channels and tactics including video, print, and web. In addition, SCE will target specific age segments (e.g., K-4, 5-6. 7-8. 9-12) with tailored messaging. Messages will be related to a broad variety of topics, including but not limited to the installation of EV charging stations on the campuses and the environmental and societal benefits of EVs. Each channel will encourage students to learn more about EVs at SCE's website, which will contain information to educate

[61] California Public Utilities Commission, Zero-Emission Vehicles Fast Facts, *available at* http://www.cpuc.ca.gov/zev/.

students about the different types of EVs, EV charging, and information related to topics like science, technology, engineering and mathematics (i.e., "STEM" education). For example, topics could include the science behind EVs, the technology of EV charging, the engineering of EVs or batteries, and the mathematics of EV charging or range. Additionally, material related to the societal benefits of EV adoption, or the available jobs in the EV market, may be presented. SCE will ensure adequate coverage among the diverse student base by developing its material in key languages spoken in its service territory, including Spanish and Asian languages.

(b) Direct Messaging

SCE will use direct messaging channels (e.g., email newsletters, school website content, and message boards) for a more personalized message. Through external research and internal customer data, SCE can identify student populations, such as those that will be more likely to adopt EVs, or those facing specific adoption barriers (e.g., MUD residents). Because the nature of direct marketing is to target specific audiences with specialized messaging, SCE can address these populations with direct and ongoing messages to help speak to each audience's unique barriers.

(c) Experiential Outreach through a Mobile EV Classroom

SCE plans to conduct outreach to build awareness through a mobile EV classroom. The vehicle will be wrapped with graphics, driven to targeted schools by actors and specialists who will deliver live action content, and will be used as a mobile EV experiential learning classroom. The vehicle may be outfitted with literature and video monitors that will deliver engaging, age appropriate EV enrichment curriculum content to the users. It may also be used to shuttle students to SCE's Energy Education Centers where classes and workshops are held. SCE plans to add EV-related graphics and audio-visual displays to one of the rooms in the Energy Education Center in Irwindale. By leveraging the mobile EV classroom, SCE will connect with hard-to-reach audiences. Student exposed to the content may become EV proponents, and may share their opinions. Studies show that children play an important role throughout the purchase process and rather than their influence

being perceived as negative, parents welcomed their input, and the knowledge and information they added to purchase decisions was seen as beneficial.[62]

(2) Gaps & Customer Needs

Various interlinked barriers prevent wider adoption of EVs,[63] including a general lack of awareness about EVs, the differences between internal-combustion engine vehicles, battery electric vehicles ("BEVs") and plug-in hybrid electric vehicles ("PHEVs"),[64] and the benefits EVs provide (individual, societal, and environmental), suggesting a need for education to support EV adoption.[65] Because awareness issues are widespread and the market transformation California is seeking will take decades to accomplish, education must not only be directed toward current adult car buyers (teachers and parents) but also toward the next generation of vehicle users (students).

(3) Objective

The objective of the Grade Level-Specific Material is to develop awareness about EVs, the benefits of EV adoption and fueling from the grid, and the growing EV-related job industry through targeted content, direct messaging, and outreach through a mobile EV classroom. The purpose of increased EV awareness is to increase EV adoption. After being exposed to the EV experience, students may become EV advocates and may share their opinions and thoughts with their parents. Studies show that children have an impact on the decision-making process and behavior of their parents.[66]

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62 *See* Pam Damerell et al., *Child-oriented environmental education influences adult knowledge and household behavior* 8 ENVIRON. RES. LETT.1 (2013)*, available at* http://iopscience.iop.org/article/10.1088/1748-9326/8/1/015016/pdf; L.A. Flurry and Alvin C. Burns, *Children's influence in purchase decisions a social theory approach,* 58 J. OF BUS. RES. 593 (2005), *available at* https://doi.org/10.1016/j.jbusres.2003.08.007; Elizabeth S. Thomson et al., *Family purchase decision making: Exploring child influence behavior,* 6 J. OF CONSUMER BEHAV.182, (Sept. 2007), *available at* https://doi.org/10.1002/cb.220.

63 *See* Section II.D for description of barriers to EV adoption.

64 *See* NREL Report*, Consumer Views on Plug-in Electric Vehicles-National Benchmark Report*, *available at* https://www.afdc.energy.gov/uploads/publication/consumer_views_pev_benchmark.pdf.

65 *See*, *e.g.*, Mark Singer, National Renewable Energy Laboratory, *The Barriers to Acceptance of Plug-in Electric Vehicles: 2017 Update*, p. 11 (Jan. 2016), *available at* https://www.nrel.gov/docs/fy18osti/70371.pdf.

66 *See* Elizabeth S. Thomson et al., *Family purchase decision making: Exploring child influence behavior,* 6 J. OF CONSUMER BEHAV.182, (Sept. 2007), *available at* https://doi.org/10.1002/cb.220.

f) Faculty Education Program

(1) Description

The Faculty Education Program will provide further education on EVs and EV charging for faculty through enhanced education and training materials, hands-on ride-and-drive events, experiential events, and a new Faculty EV proponent network. SCE intends to develop materials to help faculty better understand EVs and determine if EVs are a right fit for their needs and budget. Through this material, SCE will provide faculty with information to assist in overcoming barriers to adoption, including understanding the total cost of ownership.

In spite of rebates available to assist with purchasing or leasing an EV, the upfront cost of an EV is typically higher than a similar-in-class conventional vehicle. However, when factoring all costs over the lifetime of a vehicle, including fueling, maintenance, and repair (total cost of ownership), EVs will often offer a similar or more financially attractive option as compared to ICE vehicles. An important component of cost of ownership is fueling, both at home and on the road, and where that charging can occur. Providing away-from-home fueling options and seeing how charging behavior influences costs will help encourage faculty to consider EV adoption. Providing this holistic view of the total cost of ownership to potential EV drivers is important as a way to help them make an informed decision to adopt.

(a) Enhanced Education and Training Materials

SCE plans to develop educational and training materials in collaboration with original equipment manufacturers, local dealerships, and other stakeholders to help administrators, faculty and staff identify and select an EV that matches their needs. A study from UC Davis identified some of the challenges that EV buyers face at car dealerships such as product knowledge of sales staff, a longer sales process to explain product features, and the desire for greater

support around EV ownership after the sale.[67] Unfortunately, a more recent survey confirmed that these challenges still exist, with much room for improvement in the dealership experience.[68] Additionally, SCE plans to develop enhanced educational tools and materials to lead faculty to become educated consumers equipped with EV knowledge to enjoy a more satisfying purchase experience. In turn, these administrators and faculty, once they own EVs, can become proponents of EVs and share their experiences with their peers and students.

(b) Experiential Events

Hands-on experience with an EV and related material is a key enabler to educating drivers on the performance benefits of an EV. Until a driver has tried driving an EV, it's difficult to get the sensation across in words. Administration and faculty can gain a greater understanding and familiarity with the technology when they touch, see, feel and hear how an EV operates. SCE plans to expand upon this concept, through experiential events such as ride and drives paired with brief presentations and discussions about EVs similar to those that will be delivered to the students, focusing on science, technology, engineering and mathematics. Topics could include the science of the EV or the lifecycle emissions of EVs. This will allow administration and faculty an opportunity to become more aware of and educated about EVs, provide a pressure-free environment to test drive EVs, ask questions of trained staff, and meet others who drive EVs, including other administration and faculty. For example, the "GO FORTH Electric Showcase" in Portland, Oregon,[69] which includes trained staff and a variety of EVs for potential drivers to interact with, provides an excellent model for the type of enhanced experience SCE can develop under the proposed program.

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[67] *See* Eric Cahill, Jamie Davies-Shawhyde & Thomas S. Turrentine, *New Car Dealers and Retail Innovation in California's Plug-In Electric Vehicle Market* (Oct. 2014), *available at* https://itspubs.ucdavis.edu/wp-content/themes/ucdavis/pubs/download_pdf.php?id=2353.

[68] Press Release, Ipsos, *Ipsos RDA Study Finds U.S. Dealerships not Prepared for the EV Invasion* (November 15, 2017), *available at* https://www.ipsos.com/sites/default/files/ct/news/documents/2017-11/rda-finds-dealership-not-prepared-ev-invasion-2017-11-15-v1.pdf.

[69] Go Forth Electric Showcase, *available at* https://forthmobility.org/showcase.

(2) Gaps & Customer Needs

Advancing drivers through the EV journey is critical to ensuring EV adoption. Once drivers are aware of EVs, there is still work to be done to increase their intent and consideration in order to move closer to actual purchase. The more drivers learn and understand the nuances of EVs, the more comfortable they will become. Currently, a range of websites, organizations, and sources exist to educate the public on key EV concerns, such as cost to own, performance, or where and how to charge. Providing education through a single source such as a self-service tool or through hands-on experiences through a trusted advisor such as SCE will be important to advancing consumers through their EV journey.

(3) Objective

The objective of the Faculty Education Program is to build on the proposed EV Awareness Campaign to provide further education on EVs by combining enhanced education and training materials for stakeholders, and hands-on ride-and-drive events and experiential events. This will help to increase EV adoption.

g) EV Economic Education

(1) Description

SCE proposes to help address economic barriers to faculty and student EV adoption by providing EV economics education and outreach services. These services will primarily focus on education and awareness of financial incentives and rebates, including credit union financing, leases, and availability and pricing of secondary market EVs. SCE proposes to direct drivers to online total-cost-of-ownership self-service tools. These efforts will target faculty and students, and will address misconceptions regarding the affordability of EVs.

(a) Incentives and Rebates

SCE proposes to provide information regarding State and federal incentives for EVs, including but not limited to size of available tax credit, necessary forms, and remaining funds. Additionally, SCE proposes to provide information regarding available EV rebate and incentive programs for EV buyers, including but not limited to SCE's Charge Ready Home Installation

Rebate Program, SCE's Clean Fuel Reward, rate information, High Occupancy Vehicle Lane Access, as well as federal, State and local incentives.

(b) Secondary Market Vehicle Information

SCE proposes to provide information regarding the secondary EV market, so that administrators, faculty and students who may find the first cost of an EV to be a barrier may consider purchasing a pre-owned EV. EVs tend to be driven fewer miles than their internal-combustion engine counterparts, and should therefore have endured less wear and tear, making them a viable alternative to new EVs. SCE can provide information about the battery condition and expected life-span.

(2) Gaps & Customer Needs

Without an understanding of the cost of EV ownership over the lifetime of a vehicle, including purchase/resale, fueling, maintenance, and repair, administrators, faculty and students may face sticker shock when comparing only upfront acquisition costs, even as EV prices are dropping. Similarly, the lack of understanding of the cost of deploying and operating charging infrastructure at premises other than single-family homes is a barrier to EV adoption. Administrators may not have the time or motivation to gain an understanding of a new and potentially confusing market. Finally, EV drivers state that access to charging at home and away from home, in particular at work, is a primary concern. The UC Davis survey shows that while doubling of away-from-home charging may have occurred, away-from-home infrastructure has not kept pace with EV adoption.[70]

(3) Objective

The objective of the EV Economic Education program is to expose administrators, faculty, students and parents to information regarding State and federal incentives, utility rebates, auto insurance, and the secondary EV market to help them make informed decisions regarding

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[70] *See* Ken Kurani and Scott Hardman, *Automakers and Policymakers may be on a Path to Electric Vehicles; Consumers Aren't*, *available at* https://its.ucdavis.edu/blog-post/automakers-policymakers-on-path-to-electric-vehicles-consumers-are-not/.

their next vehicle purchase. While parents pass habits and knowledge to their children, studies have shown that children influence parental behaviors.[71] The EV Economic Education program will be a conduit of EV information in the K-12 communities served.

h) Costs

Table III-5
AB 1082 Market Education and Outreach Budget
2018$, not loaded, millions

	Year 0	Year 1	Year 2	TOTAL
Market Education & Outreach	0.23	0.69	0.30	**1.21**

B. AB 1083 Pilot

In SCE's AB 1083 Pilot, SCE plans to install, operate and maintain charging stations and accompanying make-ready infrastructure at approximately 27 State park and beach locations. The infrastructure deployment will contain a mix of Level 2 and DCFC ports for light-duty EVs as well as test portable charging solutions for locations that would otherwise require costly electrical systems upgrades to serve charging stations. Additionally, AB 1083 will deploy a customer marketing campaign to publicize the availability of EV charging stations at Parks and increase awareness more broadly about the availability of EV charging in many locations across the State, even those that may seem remote, in order to reduce range anxiety and facilitate EV adoption.

1. Infrastructure

a) Objectives

The broad objective of the AB 1083 pilot is to accelerate adoption of EVs in SCE territory to support the State's GHG and air quality goals through deployment of Level 2 and DCFC charging stations to help alleviate a key barrier to EV adoption—charger availability and convenience.

The specific objectives of the AB 1083 Pilot are to:

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[71] *See* K. Ekstrom, P. Tansuhaj, & E. Foxman, *Children's Influence in Family Decisions and Consumer Socialization: a Reciprocal View* (1987), *available at* http://acrwebsite.org/volumes/6704/volumes/v14/NA-14.

- Support the mission of the Parks: "To provide for the health, inspiration and education of the people of California by helping to preserve the state's extraordinary biological diversity, protecting its most valued natural and cultural resources, and creating opportunities for high-quality outdoor recreation;"[72]
- Facilitate deployment of EV charging infrastructure that enables visitors of the Parks to charge while they recreate;
- Enable electrification of the Parks' fleet; and
- Test the effectiveness of encouraging EV adoption more broadly by installing EV charging infrastructure in remote areas where little charging infrastructure exists today.

b) Description

The AB 1083 Pilot at State parks and beaches will provide infrastructure to serve (1) EV charging for Park fleet and employee vehicles and (2) EV charging for Park visitors.

SCE will install Level 2 chargers and (in some sites) DC Fast Chargers, with site design to vary based on the needs of the particular Park and the constraints of the site. SCE estimates that as many as 120 Level 2 charging ports and 10 DCFC ports could be installed at approximately 27 Park locations during the Pilot.[73]

SCE proposes to build, own, and operate the charging stations. Pursuant to AB 1083, "the Department of Parks and Recreation shall not be required to incur any costs or liability related to the installation, use, or maintenance of the charging stations for the pilot program's duration."[74] SCE will contract with a third-party EV charging station service provider to serve as the

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[72] *See* California Department of Parks Recreation, "*Our Mission*," *available at* https://www.parks.ca.gov/?page_id=91.

[73] Site locations depend upon requests made by each participating site. SCE has assumed an average port deployment of 4.5 ports per site based on survey data and conversations with State parks and beaches in SCE territory.

[74] Cal. Pub. Util. Code § 740.14(f).

customer of record for the EV charger. The third party would then be responsible for paying for the electricity associated with the charging station and could collect revenue from the users of the charging stations. SCE will coordinate with each Park and set reasonable charging rates for Park visitors. Charging station installations serving Park fleets will be billed to the Park directly.

To help inform the AB 1083 Pilot, SCE communicated with the California Department of Parks and Recreation and held multiple in-person and online meetings with individual State Parks located in SCE territory. The State Park Districts provided survey responses that SCE used to size and design the Pilot proposal. SCE and the Parks identified sites with interested in EV charging. In some of these sites, it is likely that upgrading the existing electrical infrastructure will be cost prohibitive given the limited existing capacity and the distance from higher-capacity electrical infrastructure. In these instances, SCE will consider providing an off-grid solution[75] to supply charging without requiring electrical infrastructure upgrades. SCE may also consider off-grid mobile solutions at sites to test usage and determine potential future charging needs and integration into long-term programs. SCE will conduct an RFP to select vendors and procure up to 15 off-grid units.

SCE proposes to own, operate and maintain portable or off-grid solutions charging solutions at all sites to ensure that the Parks incur no costs or liability related to the installation, use, or maintenance of the charging stations.

c) Gaps and Customer Charging Needs

In addition to serving a market segment identified by the legislature as important enough to be specifically targeted, SCE reached out to the California State Parks Department as well as State Park District heads in SCE's territory to discover significant interest in increasing charging stations. In addition to serving Park patrons, California State agencies (including Parks) have increased

[75] *See* Appendix B – Examples of Portable EV Charging Devices.

EV procurement targets.[76] SCE research found that the 69 locations could need as many as 266 charging ports to meet staff and patron needs.

d) Scope and Cost

(1) Customer and Site Eligibility

The AB 1083 Pilot is limited to California State parks and beaches. Participating customers must provide SCE with the rights-of-way across public or private property (as applicable) and obtain any necessary permits satisfactory to SCE.

Site deployment size will not be constrained by the size of the parking lot, but a minimum of two ports per site will be required to participate in the Pilot. Participating customers must have an Edison SmartConnect® meter or interval data recorder ("IDR") meter dedicated to registering charging site loads. All charging site load must be separately metered from any other load served at the premises or be measured by another equivalent way to verify charging load acceptable to SCE.

The customer of record (e.g., site host, EVSP) will be required to take service on one of SCE's time-differentiated rates, but the customer of record will have flexibility to set pricing and parking restrictions for drivers charging at the site. SCE will encourage participating customers to pass SCE's TOU rate through directly to drivers, but participating customers may elect to implement their own pricing plans. Regardless of the customer's billing selection, participating customers will be required to participate in a demand response program. SCE will also require participating customers to report prices charged to drivers. SCE will provide aggregate information to its TE Advisory Board on a quarterly basis. SCE will work to educate participating customers to ensure

[76] *See* California State Department of General Services, *Electric Service Equipment Infrastructure and the Five-Year Zero Emission Vehicle Infrastructure Readiness Survey Vehicle – Guidance Document,* p. 2 (Dec. 2016), *available at* https://www.documents.dgs.ca.gov/dgs/pio/EVSEGuidanceDocument.pdf.

that end-use pricing is easy for drivers to understand and provides the opportunity for drivers to access electricity that is less costly than gasoline while meeting the needs of participating customers.[77]

(2) Site Prioritization Criteria

Per AB 1083, the Parks are authorized to select which sites are suitable for charging. If the Pilot is approved, SCE will assess sites to identify which (a) have higher numbers of visitors and therefore are more likely to have higher need for chargers, (b) serve residents of disadvantaged communities, (c) exist near transit corridors where there is minimal existing or planned DC fast charging, and (d) have access to appropriate electrical infrastructure or are appropriate for an off-grid solution. SCE will reserve funding minimums for each District to ensure more equitable distribution of charging stations throughout its territory and allow for diversity of installations.

(3) Accommodating Future Needs

SCE will work with customers to plan for future site growth and may install hardware with additional capacity (e.g., panels and transformer pads) and infrastructure to accommodate future charging stations (e.g., trenching, conduit, wire) and electrical needs. Having the infrastructure pre-installed will allow the charging stations to be added easily and economically at a later date. Customers will be required to provide a commitment to install additional charging stations within a defined time period. This will aid in achieving and reducing the cost of Governor Brown's interim goal for infrastructure[78] and SCE's forecasted charging station need, to support California's long-term zero-emission vehicle goals. SCE will work with participating customers and electrical contractors to identify appropriate locations within the participating customer's parking lot to deploy charging stations economically (based on factors such as proximity to transformers, length of trenching, available

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[77] Cal. Pub. Util. Code § 740.12 (a)(1)(H) states that deploying electric vehicle charging infrastructure should facilitate increased sales of electric vehicles by making charging easily accessible and should provide the opportunity to access electricity as a fuel that is cleaner and less costly than gasoline or other fossil fuels in public and private locations.

[78] Gov. Brown's Zero-Emission Vehicle Executive Order proposes to expand zero-emission vehicle infrastructure throughout California. Exec. Order No. B-48-18 (Jan 2018), *available at* https://www.gov.ca.gov/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/.

transmission and distribution capacity, and ease of access for EV drivers). SCE representatives will also help identify alternative locations, as needed. SCE may deny a customer's request to participate in the Pilot if the customer and SCE cannot agree upon an installation configuration and location that is reasonably economical, as determined by SCE in its sole discretion.

(4) Qualified Vendors, Products and Services

To promote competition and customer choice, SCE intends to include a broad range of qualified charging station models and network service providers from multiple suppliers as part of the Pilot offering. SCE will issue a RFI to technically capable and financially viable third-party suppliers, including qualified WMDVBE suppliers, to cover the provision, installation, operation, networking and maintenance of the charging stations. Prospective suppliers will be asked to submit sample models to supply and install qualified charging stations, based on the RFI's requirements. Suppliers will have to demonstrate capabilities to supply qualified stations in appropriate volumes, and to provide maintenance and network-related services (e.g., charging data collection and management), either through the charging station or through a kiosk or gateway.

To qualify for the Pilot, charging station equipment and controls will be evaluated against established standards (e.g., SAE J2836, IEEE 2030) and must comply with technical standards and energy efficiency recommendations (e.g., SAE Standards J1772, J2894, J2847, J3068; Title 20) and be listed by a nationally recognized testing laboratory. DCFC charging stations must adhere to the basic requirements of a Direct Current ("DC")-based EVSE, which must use recognized and approved DC standard charging connectors and additionally be capable of charging at power levels of 50 kilowatts ("kW") or greater.[79]

[79] Currently approved DC charging connectors are Combined Charging System ("CCS") or CHAdeMO. *See* Appendix C – Charging Standards and Definitions. EV connector specifications and others are defined in the appendix. In the decision on Pacific Gas and Electric Company's ("PG&E's") standard-review projects, the Commission noted: "While we support the choice of the site host to select their EVSE power level, given the current trends of increasing battery size and higher powered charging stations, it is prudent for PG&E to install the customer-side electric infrastructure necessary to support EVSE of 150 kW or larger at all DCFC sites in the Fast Charge program to account for the possibility that the site host may wish to upgrade to higher-powered EVSE in the future." D.18-05-040, p. 74. SCE believes charging at power levels of 50 kW is

In addition, all grid-connected Level 2 and higher output EVSEs, such as DCFCs,[80] must be demand-response capable (e.g., capable of receiving and executing real-time instructions to reduce and modify end-user pricing of EV charging load) and are encouraged to include additional load management features (e.g., EV charging sequencing or power sharing). EVSE must be controllable by SCE, either directly or through a vendor cloud service (e.g., OpenADR 2.0b), and must have the capabilities for each port to be independently controllable from 0 – 100 percent linear throttling.

(5) Customer Engagement and Enrollment

SCE will market to potential customers via email, print, web, and directly through interaction with relevant SCE account managers serving the State Parks. SCE intends to inform the State Park and Recreation Commission of the Pilot specifics and benefits, and to make them aware that presentations will be delivered to park management and staff. Emails deployed to the management will include a link to new a new webpage where they will find a description of the Pilot, its benefits, and information about the application process. Outreach to Park management and staff will focus on the details and benefits of the Pilot. Messages may include the benefits of attracting new Park visitors, adding EV program material to the Park's offerings, and the application and installation process.

(6) Demand Response

As discussed above, SCE will require all grid-connected Level 2 charging stations to participate in a demand response program.[81] SCE will apply these strategies to the AB 1083 Pilot. The AB 1083 Pilot will follow the same DR strategies as AB 1082. Please see Section III.A.e.6 for more details.

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more appropriate and provides flexibility for mass market vehicles that have smaller batteries and may not have the cooling provisions to be able to support 150 kW charging.

[80] *See* Appendix C – Charging Standards and Definitions.

[81] *See* Sections III.B.1.e.6 and III.C.1.e.6 for discussion of the Charge Ready demand response pilot.

(7) Data Collection and Reporting

In addition to quarterly status reports presented to the Transportation Electrification ("TE") Advisory Board, SCE proposes to provide a close-out report to the Commission's Energy Division and other interested stakeholders after the completion of the Pilot. The proposed report will evaluate data across all pilot activities, including but not limited to: (i) customer enrollment and participation data; (ii) process information; (iii) installation costs; and (iv) customer usage data (e.g., EV usage data, transactions per day). The Advisory Board updates will include information on progress, achievements, and lessons learned.

(8) Cost Components

For the proposed AB 1083 Pilot, SCE incorporated lessons learned from the Charge Ready Pilot to reduce costs. For example:

- Packaged Site Designs: SCE developed threshold site sizes that trigger major equipment size changes. The switchgear and metering panels are a significant cost driver for each site and packaging in various sizes should allow SCE to leverage buying power for multiple panels at once rather than the site-specific, special-order approach used in the Charge Ready Pilot.
- Site Feasibility Reviews: SCE will perform a high-level review of each site prior to engaging a design firm for a formal site assessment, saving on engineering fees for locations that cannot proceed due to site conditions.
- Ability to Use Customer Distribution Facilities: SCE may take a service drop from a customer transformer when there is sufficient existing capacity and it is deemed by SCE to be more economical than creating a stand-alone SCE line extension.
- Streamlined Plan Check Processes and Reduced Fees with AHJs: SCE intends to coordinate working sessions with AHJs to reduce

the timing and costs associated with permitting and plan checks. Based on the volume of sites across its various programs, SCE hopes to minimize costs and time by leveraging the State's EV mandates to influence AHJ performance and fees.

SCE's cost estimates were developed using actual results realized in the Charge Ready Pilot and a detailed analysis of specific activities completed by each organization contributing to the Charge Ready Pilot implementation. Additional costs were estimated based on primary and secondary research into charging equipment providers and marketing experts. SCE will conduct a new RFP, where appropriate, for procurement of charging stations and services.

Capitalized Costs

- Utility-Side Costs – SCE developed utility-side cost estimates using actual costs from sites participating in the Charge Ready Pilot. Two installation examples (fixed meter and service, and line extension meter and service) were developed and scaled to two different deployment scenarios to align with smaller deployments requested by the Parks Districts. These costs include labor, materials (transformer, cable, duct) and design and permitting costs up to the SCE meter.
- Customer-Side Costs – SCE developed customer-side cost estimates in consultation with internal subject matter experts and RFP responses from external electrical contractors participating in the Charge Ready Pilot. These costs include customer site design (additional costs included for Division of State Architects inspection and soil testing[82]), planning, engineering, construction

[82] DSA inspection and soil testing is required for State sites. SCE is working with DSA to streamline the process and minimize costs where possible.

(including trenching) labor, and materials from the SCE meter to the stub out.

- Charging Stations – Charging station costs based on average total cost of charging stations procured during the Charge Ready Pilot. SCE will own all charging stations deployed as part of this Pilot.
- Portable Charging Devices – SCE includes costs for portable charging units based upon an initial survey of market offerings.
- Contingency – SCE includes a 10 percent contingency[83] in its utility-side and customer-side infrastructure costs.
- Other Capitalized Costs – Other capitalized costs include easement-related expenses, charging equipment testing to verify that charging stations meet requirements of the Pilot, and all capitalized labor.

O&M Costs

- Charging Station Operation and Maintenance – O&M costs are derived from actual costs realized in SCE's Workplace Charging Pilot and include software, ADR functionality, cellular service contract, maintenance contract, back office support, and payment transaction fees.
- Labor – Forecasted labor captures all organizations required to implement the Pilot outside of capitalized labor. Labor estimates were determined by detailing unique implementation activities including, but not limited to, procurement, customer enrollment, infrastructure deployment, management and post-deployment customer support and operations.

[83] In D.18-05-040, p. 103, the Commission approved a 10 percent contingency to establish the budget for standard-review projects.

- Other Non-Labor – Other non-labor operation and maintenance ("O&M") expenses include preparation of reports and creation of marketing materials.
- Ongoing O&M costs following the two-year pilot will be captured in subsequent general rate case requests.[84]

Table III-6
AB 1083 Infrastructure Pilot Budget
2018$, not loaded, millions

Capital Cost	**Year 0**	**Year 1**	**Year 2**	**TOTAL**
Utility-side Costs (make-ready)	-	0.9	0.9	**1.9**
Customer-Site Cost (make-ready)	-	1.5	1.5	**2.9**
Ownership Station Cost (incremental)	-	0.5	0.5	**1.0**
Portabe Units (owned)	-	0.5	0.5	**1.0**
Non-labor (Capital)	0.0	0.0	0.0	**0.0**
Labor (Capital)	0.0	0.1	0.1	**0.2**
TOTAL	**0.0**	**3.5**	**3.5**	**6.9**
Program O&M				
Non-labor (Expense)	-	0.0	-	**0.0**
Labor (Expense)	0.2	0.3	0.2	**0.8**
Ownership and Operation O&M	-	0.1	0.1	**0.2**
TOTAL	**0.2**	**0.4**	**0.4**	**1.0**
Infrastructure Subtotal	**0.2**	**3.9**	**3.8**	**7.9**

e) Disadvantaged Communities

As destination centers, State Parks are visited by customers throughout SCE's territory. AB 1083 states that Pilot programs must prioritize State Parks that serve residents of disadvantaged communities.[85] However, robust data measuring the overlay of park attendance and DACs is limited or not available at all. Consequently, SCE will utilize visitor demographic data when

[84] D.18-05-040, p. 125.

[85] Cal. Pub. Util. Code § 740.14(e).

available from the Parks as well as Parks' proximity to DACs when prioritizing sites for acceptance into the Pilot.[86]

f) Partners and Leveraged Funding

California agencies provide important, limited funds for the purchase of EVs. SCE's Pilot would provide funding for make-ready infrastructure and charging stations, which will complement public funding targeting the incremental cost of EVs and support the acceleration of transportation electrification by mitigating cost barriers. Additionally, SCE will work with other utilities implementing similar pilots to leverage research, materials and funds where appropriate.

g) Duration

As directed by the Assigned Commissioner's Ruling, SCE is requesting approval for a two-year Pilot.[87]

2. Marketing, Education and Outreach

a) Customer Marketing Program

(1) Description

The Marketing, Education and Outreach will be designed for and delivered to a targeted population of State Park users, advocates, employees, or those who engage in outdoor activities like group outings, hiking, biking, camping, and boating. To facilitate use of the charging equipment by visitors and raise awareness about the environmental benefits of EVs, SCE will include educational signage near the charging stations. Content and visuals will be approved by the Parks before signage is installed. SCE may also work with the Parks to host events at sites where EV charging stations are installed to raise awareness about the presence of the charging stations and educate visitors about the benefits of EVs.

SCE also proposes to include a media campaign publicizing the availability of EV charging at select State Parks. The objectives of this media campaign are (1) to raise

[86] Approach assumes that park locations close to DACs have a higher likelihood of being visited by residents of those communities.

[87] ACR, p. 4.

awareness among potential Park visitors about available EV charging at the Parks, encouraging them to drive electric vehicles on their future trips to the Parks, and (2) to increase awareness more broadly about the availability of EV charging in many locations across the State, even those that may seem remote, in order to reduce range anxiety and facilitate EV adoption.

The campaign could include, but is not limited to, digital marketing, radio ads, billboards, and print media. Appropriate channels will be chosen based on the target audiences and key messages that are developed. Digital marketing can provide a lower-cost way to target very specific audiences. For example, digital ads may be placed to catch the eye of people researching new cars, and geofencing can be used to notify customers in the vicinity of the Park. Radio ads and billboards help target audiences when they are outside of the home. These channels can be used to target people at times and places when they are most likely to be thinking about their driving behaviors. For example, radio ads could play on weekends when drivers may be taking road trips. Billboards can be placed on transit corridors where they catch the eye of drivers thinking about their commute and other driving activities. If used, radio ads and billboards will be selectively placed to maximize impact at minimized costs.

(2) Gaps & Customer Needs

Various interlinked barriers prevent wider adoption of EVs,[88] including a general lack of awareness about EVs (e.g., EV costs, EV benefits, differences from internal-combustion engine vehicles[89]) and charging infrastructure (e.g., station availability, charging costs, ease of use), suggesting a need for broad education to support EV adoption.[90] In particular, EV drivers state that access to charging away from home is a primary concern.[91] A UC Davis survey shows that while

[88] *See* Section II.D for description of barriers to EV adoption.

[89] *See* NREL Report*, Consumer Views on Plug-in Electric Vehicles-National Benchmark Report*, (Jan. 2016) *available at* https://www.afdc.energy.gov/uploads/publication/consumer_views_pev_benchmark.pdf.

[90] *See*, *e.g.*, Mark Singer, National Renewable Energy Laboratory, *The Barriers to Acceptance of Plug-in Electric Vehicles: 2017 Update*, p. 11 (Nov. 2017), *available at* https://www.nrel.gov/docs/fy18osti/70371.pdf.

[91] *Id*., p. 17.

doubling of away-from-home charging may have occurred, away-from-home infrastructure has not kept pace with EV adoption.[92] The perceived lack of away-from-home charging availability is a significant barrier that can be addressed through a marketing campaign directed at informing customers that charging is available where and when they may need it.

(3) Objective

The objective of the AB 1083 awareness campaign is to develop awareness through multiple marketing channels about the availability of EV charging stations at State Parks and the convenience of charging at these destination locations.

b) ME&O Implementation

(1) Collaboration and Partnerships

SCE proposes to coordinate its market education efforts closely with industry and government stakeholders at the local and State levels. SCE has demonstrated its experience and willingness to work with stakeholders to educate residential and business customers about EVs. Through the proposed new efforts, SCE intends to continue and expand these collaborations by working with the State Parks Department, local communities and other utilities.

(2) Creative Agencies and Vendors

SCE plans to implement the proposed efforts with a combination of in-house resources, third-party creative agencies and other vendors. When SCE procures these services from third parties, SCE utilizes a consistent set of professional service vendors which support all SCE ME&O programs. These vendors are awarded contracts based on SCE procurement policies and procedures, including a competitive RFP process, subject to SCE's WMDVBE requirements.

(3) Data Collection and Reporting

The media campaign will be monitored to understand its impact and track whether it meets its objectives. Metrics may include click through rate, bounce rate, unique visitors and

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[92] *See* Ken Kurani and Scott Hardman, *Automakers and Policymakers may be on a Path to Electric Vehicles; Consumers Aren't* (accessed May 2018), *available at* https://its.ucdavis.edu/blog-post/automakers-policymakers-on-path-to-electric-vehicles-consumers-are-not/.

repeat visitors. Surveys will be conducted to understand whether those in targeted areas (1) have seen the campaign, (2) are more aware of EV charging availability in California State Parks than those in non-target areas, and (3) have different perceptions of EVs or a different willingness to buy an EV than those in non-target areas.

(4) Duration

The media campaign will run in the second year of the Pilot after charging stations have been deployed at Park locations.

c) Costs

Table III-7
AB 1083 Market Education and Outreach
2018$, not loaded, millions

	Year 0	Year 1	Year 2	TOTAL
Market Education & Outreach	0.15	0.93	0.92	**1.99**

C. AB 1082 and 1083 Pilot Benefits

1. Infrastructure

AB 1082 and 1083 Pilots will reduce barriers to EV adoption through deployment of EV charging infrastructure, increasing the availability of charging stations to reduce range anxiety. Specifically, the AB 1083 Pilot will explore a novel approach to deploying charging infrastructure in areas that are more remote. Additionally, the AB 1082 Pilot will increase customer awareness about the benefits of EVs through broad and targeted education programs with a unique emphasis on educating future (students) and current (parents and teachers) drivers about the characteristics and benefits of electric vehicles, while also deploying EV charging infrastructure in visible and useful locations. These Pilots are intended to facilitate widespread adoption of light-duty EVs throughout California, in support of the State's climate goals. By increasing EV adoption, the program contributes to improved air quality in SCE territory and reduces GHG emissions broadly.

The Pilots' benefits include:

- *Maintain safety* – AB 1082 and 1083 Pilots will follow standard SCE practices and procedures and will be performed safely, and to code, by SCE employees or by certified and licensed contractors. SCE make-ready infrastructure in the AB 1082 and 1083 Pilots that is not performed by SCE employees will be performed by a contractor signatory to the International Brotherhood of Electrical Workers ("IBEW") holding a valid C-10 contractor's license and Electric Vehicle Infrastructure Training Program ("EVITP") certification.
- *Environmental and other air quality benefits* – Increased EV adoption and fueling from the grid will benefit the entire southern California region by reducing GHGs and contributing to improved air quality. Based on SCE's vehicle forecast, SCE estimates that over 20 million metric tons of GHG, over 17,000 cumulative tons of NOx, and over 51,000 cumulative tons of VOCs could be reduced through 2030 statewide from the transportation sector through electric conversion.[93]
- *Integrates renewables and minimizes costs to the grid* – AB 1082 and 1083 Pilots provide more charging options for EV drivers, while encouraging participating customers to pass through TOU rates to drivers and requiring participation in a DR program. Each of these options limits grid impacts and helps to integrate renewables onto the electrical system.
- *Increases customer charging options* – The AB 1083 Pilot, which will provide DCFC as an option, will increase the dispersion of this needed technology. DCFC charging stations at State parks and beaches will help alleviate a key barrier to EV adoption—charger availability and convenience. The additional piloting of off-grid charging will test a solution for sites that would otherwise require cost-prohibitive infrastructure to be installed. By increasing access to

[93] *See* Appendix A. Incremental GHG emissions abatement associated with the 5 million vehicles over "economic adoption" scaled to reflect the total 7 million vehicles.

both slow and fast charging, SCE is helping to overcome key adoption barriers and will help accelerate adoption of EVs.

2. Market Education & Outreach

With any new technology, building awareness is critical to success. SCE believes that increasing awareness of EVs and their benefits will lead to greater consideration in the vehicle purchase cycle. More customers must become aware of EVs and their benefits to think of them when buying or leasing a new or used vehicle. SCE intends to build on its prior efforts to amplify EV and charging awareness. SCE's message about the benefits of EVs is consistent with SCE's *Clean Power and Electrification Pathway* white paper. Customers are looking to SCE to help provide a modern grid, facilitate higher levels of renewable energy generation, improve air quality, and help make EVs more affordable.[94]

By addressing awareness, one of the most significant barriers to EV adoption, SCE's ME&O proposal will, first and foremost, seek to accelerate greater adoption of EVs. Additionally, the multiple components of the ME&O strategy will improve customer awareness of the value of EV charging during high renewable generation periods.

The proposed ME&O activities are designed to generate several benefits for SCE's customers. ME&O will help customers understand that EV charging easily fits into their lives by being available at the places they already go. These efforts will promote charging when grid capacity is high and integration with renewable energy generation through the newly approved EV rates.[95] The Pilots' ME&O activities aim to develop awareness about the ease of EV charging and the benefits of fueling from the electric grid for residential customers. The AB 1082 and 1083 Pilots focus on a targeted customer group. Teachers and students exposed to the content may become EV proponents, and may share their opinions with their parents. Additionally, the Pilots promote a narrow message on charging availability. Unlike Charge Ready 2, the AB 1083 Pilot specifically raises awareness among potential

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[94] SCE conducted a focus group on November 27, 2017, with Unisearch Partners to explore reactions to the communication ideas about SCE leading California toward a clean energy future.

[95] *See* D.18-05-040, approving SCE's new EV rates.

Park visitors about available EV charging at the Parks, encouraging them to drive electric vehicles on their future trips to the Parks and to increase awareness more broadly about the availability of EV charging in many locations across the state, even those that may seem remote, in order to reduce range anxiety and facilitate EV adoption.

Absent the education and outreach proposed in the AB 1082 Pilot, next-generation drivers could have the same knowledge gaps as their parents and faculty, and would likely not consider EVs as their future vehicles, whether they purchase, lease, or ride-share. Their vehicle purchasing decisions would likely be limited to internal-combustion engine vehicles, further delaying the adoption of EVs. Early outreach programs can overcome this cycle by simply educating future drivers as they progress through grades K-12 to avoid the time-consuming and expensive process of re-educating students after they have formed opinions as adults. Additionally, children can have a great deal of influence on the buying habits of their parents. Students are in a position where they can effectively be used as change agents to use their knowledge, skills, and attitudes concerning the environment to influence parents and other community members. By actively involving students in home learning projects, children and families will benefit from the discussion and increased interaction as they learn to be environmentally responsible together.[96]

[96] Peggy Mandel, *Children as Change Agents: The Influence of Integrating Environmental Education into Home Learning Projects on Families and Community Members*, p. 78 (2013), *available at* https://core.ac.uk/download/pdf/46946326.pdf.

IV.

SCE'S PROPOSED AB 1082 AND 1083 PILOTS SATISFY STATUTORY AND REGULATORY GUIDELINES

As discussed above, the transportation sector is the most significant GHG emitter in California, accounting for 41 percent of in-State emissions.[97] Direct emissions from the transportation sector are also the largest contributor to the formation of ozone and emissions of small particulate matter and diesel particulate matter, accounting for nearly 80 percent of nitrogen oxide emissions and 90 percent of diesel particulate matter emissions in the State.[98] To meet California's aggressive climate change goals and to protect public health and the environment, the State will need to dramatically reduce these emissions in the coming years by, among other measures, approving SCE's proposed Pilots. Numerous policy drivers and programs are now in place that, if successful, will help achieve these goals.[99] As demonstrated below, SCE's AB 1082 and 1083 Pilots meet the statutory requirements[100] and conform to the guidelines established in Commissioner Peterman's January 24, 2018 ACR.[101]

A. SCE's AB 1082 and 1083 Pilots Contain a Reasonable Cost Recovery Mechanism.[102]

SCE proposes that if the AB 1082 and 1083 Pilots actual direct capital and O&M expenditures are consistent with the scope and within the cost levels adopted by the Commission, then those expenditures should be deemed to be reasonable and no further after-the-fact reasonableness review would be required. Pursuant to the Commission-adopted process for reviewing other SCE balancing accounts, including the Charge Ready Program Balancing Account ("CRPBA") for the Charge Ready

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97 *See* CARB, *California Greenhouse Gas Inventory 2000-2016 – by Economic Sector Categorization* (July 11, 2016), *available at* https://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_sector_sum_2000-16.pdf.

98 CARB, *Mobile Source Strategy,* p. 5 (May 2016), *available at* https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf

99 California Energy Commission**,** *2017 Integrated Energy Policy Report***,** Publication Number: CEC-100-2017-001-CMF (Feb. 2018), *available at* http://www.energy.ca.gov/2017_energypolicy/.

100 *See* Cal. Pub. Util. Code § 740.13(e); Cal. Pub. Util. Code § 740.14(b).

101 ACR, pp. 4-7.

102 *See* Cal. Pub. Util. Code § 740.13(e); Cal. Pub. Util. Code § 740.14(b).

Pilot[103] and the Transportation Electrification Portfolio Balancing Account ("TEPBA"),[104] SCE proposes that the recorded operation of the CRPBA AB 1082 and 1083 Pilots subaccount, which will include separately-recorded costs for the AB 1082 and 1083 Pilots as described in Section V.A. of this testimony, be reviewed by the Commission in SCE's annual Energy Resource Recovery Account ("ERRA") Review Application. This continuing review of the CRPBA for AB 1082 and 1083 Pilot activity in the ERRA Review proceeding will ensure that all entries to the account are stated correctly and are consistent with Commission decisions. Commission review procedures for AB 1082 and 1083 Pilots costs should be limited to ensuring that all recorded costs are associated with activities as defined and adopted by the Commission in this proceeding. Additional cost recovery details are provided in Section V of this testimony.

B. SCE's AB 1082 and 1083 Pilots Are Consistent with the Cost Limitation Set by the Commission.[105]

Consistent with the statutory requirement, the ACR suggested "a budget for each pilot's direct costs not to exceed $10 million, unless the utility provides clear evidence as to why a larger budget is necessary."[106] Consistent with this guidance, SCE's proposed budget for each Pilot does not exceed $10 million.

C. SCE's AB 1082 and 1083 Pilots Seek to Minimize Costs and Maximize Benefits.[107]

The Pilots will minimize costs by incorporating lessons learned from the Charge Ready Pilot from packaged site designs to streamlined plan check processes and reduced fees with AHJs. Examples are described in further detail in Section III.A.2. The Pilots will maximize benefits from EVs by requiring that customers participating in the proposed Pilots take service on a TOU rate plan, which incentivizes charging in a manner consistent with grid conditions. As noted in the recent Commission

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[103] *See*, *e.g.*, Advice Letter 3502-E.

[104] *See*, *e.g.*, Advice Letter 3734-E.

[105] *See* Cal. Pub. Util. Code § 740.13(e)(1); Cal. Pub. Util. Code § 740.14(b)(1).

[106] ACR, p. 4.

[107] *See* Cal. Pub. Util. Code § 740.13(e)(2); Cal. Pub. Util. Code § 740.14(b)(2).

decision adopting updated TOU periods proposed by SCE (including shifting the peak period to later in the day and implementing a winter season super-off-peak period during daytime hours), "properly defined TOU periods will provide incentives for customer use and development of future generation that better reflects the state's electric grid. This, in turn, should assist in reaching state energy goals by minimizing costs, reducing [GHG] emissions, encouraging conservation, and increasing the supply of electricity at times that best serve the needs of the grid."[108] Moreover, the ME&O component of the Pilots will increase awareness of EVs and their benefits, which can lead to greater consideration in the vehicle purchase cycle. More customers must become aware of EVs and their benefits to think of them when buying or leasing a new vehicle. SCE is also committed to prioritizing sites in DACs to facilitate access to charging stations, environmental and other air quality benefits, and increased customer charging options.

D. SCE's AB 1082 and 1083 Pilots Fairly Compete with Non-Utility Enterprises[109]

SCE intends to follow the same market-neutral approach demonstrated with the Charge Ready Pilot while balancing customer needs for flexibility. This approach consists of deploying electric infrastructure that the utility owns and maintains—or at participating customers' elections, they may construct and own the portion of the infrastructure on their premises—while site hosts select, own, operate, and maintain qualified charging equipment (except where SCE owns and operates the charging equipment). SCE's proposed ownership in these Pilots, if fully subscribed, represents only a small portion of the current number of charging stations operating in its territory and an even smaller proportion of the expected significant growth in public charging stations needed in the coming years.[110] Additionally, SCE will procure charging stations from multiple vendors. When qualifying charging

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[108] D.18-07-006, p. 9.

[109] *See* Cal. Pub. Util. Code § 740.13(e)(3); Cal. Pub. Util. Code § 740.14(b)(3).

[110] The pilots estimate a total of 370 Level 1 and Level 2 make readies and charging stations could be deployed. SCE territory currently has over 4,500 charging stations with an SCE projected 22,000 public and workplace charging stations needed in SCE territory by 2021.

equipment, SCE plans to rely on adopted efficiency and safety standards to define its requirements and accept a large number of vendors and charging equipment models.

E. SCE's AB 1082 and 1083 Pilots Contain Trackable Performance Accountability Measures[111]

SCE proposes to prepare reports at the conclusion of the Pilots and to provide interim status updates on their implementation to the Commission and interested stakeholders. The updates will, where feasible, provide a high-level summary, the amount of funds expended to date, and the status of each Pilot. In the final reports, SCE will provide:

- aggregated customer participant data (e.g., market segment, DAC participation, usage profiles, charger utilization, load management information);
- operational metrics such as average times to complete milestones in the installation cycle (e.g., average customer "end-to-end" cycle time by segment, number of completed installations, expended funds);
- marketing materials (e.g., expended funds, description of materials, media outreach, published articles);
- outreach events (e.g., outreach type, location, estimated number of customer interactions); and
- other findings and lessons learned that could be applied to an expanded program.

F. SCE's AB 1082 and 1083 Pilots Are in the Interests of Ratepayers Per §740.8[112]

SB 350 modified Public Utilities Code §740.8 to require demonstration of both of the following types of ratepayer benefits:

- Safer, more reliable, or less costly gas or electrical service, consistent with §451, including electrical service that is safer, more reliable, or less costly due to either

111 *See* Cal. Pub. Util. Code § 740.13(e)(4); Cal. Pub. Util. Code § 740.14(b)(4).

112 *See* Cal. Pub. Util. Code § 740.13(e)(5); Cal. Pub. Util. Code § 740.14(b)(5).

improved use of the electric system or improved integration of renewable energy generation.

- And any one of the following:
  - Improvement in energy efficiency of travel.
  - Reduction of health and environmental impacts from air pollution
  - Reduction of greenhouse gas emissions related to electricity and natural gas production and use.
  - Increased use of alternative fuels.
  - Creating high-quality jobs or other economic benefits, including in disadvantaged communities identified pursuant to §39711 of the Health and Safety Code.[113]

The AB 1082 and 1083 Pilots meet these requirements for both types of ratepayer benefits identified in §740.8. The AB 1082 and 1083 Pilots contribute to safer, more reliable, or less costly gas or electrical service[114] through (i) improved use of the electric system and potential downward pressure on rates, and (ii) improved integration of renewable energy generation.[115] In addition, the proposed initiatives contribute to supporting EV adoption and will help displace diesel or gasoline petroleum usage with electricity, resulting in environmental and societal benefits consistent with §740.8, such as substantially reducing GHG, NOx, and particulate matter emissions.[116]

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[113] Cal. Pub. Util. Code § 740.8.

[114] The Natural Resources Defense Council's report shows how well-managed EVs benefit all utility customers through improved use of the electric system and integration of renewables. *See* Max Baumhefner & Roland Hwang, *Driving Out Pollution: How Utilities Can Accelerate the Market for Electric Vehicles* (June 16, 2016), *available at* https://www.nrdc.org/resources/driving-out-pollution-how-utilities-can-accelerate-market-electric-vehicles.

[115] *See* Section II.C.

[116] *See* Section II.B.

G. SCE's AB 1082 and 1083 Pilots Will Use Workers Paid the Prevailing Wage or Employed by the Utility to Install Charging Stations[117]

SCE anticipates that its AB 1082 and 1083 Pilots will create many jobs for electricians, engineers, and construction workers.[118] SCE plans to contract for many required services, potentially including engineering, design, construction, installation, and maintenance. SCE make-ready infrastructure in the AB 1082 and 1083 Pilots that is not performed by SCE employees will be performed by a contractor signatory to the IBEW holding a valid C-10 contractor's license and EVITP certification. IBEW signatories would be paid in accordance with their applicable Collective Bargaining Agreements. SCE is currently awaiting confirmation from the Director of Industrial Relations as to whether it has set specific prevailing wage rates for the type of work contemplated by AB 1082 and 1083. However, given that prevailing wage rates are usually based on rates specified in relevant collective bargaining agreements, SCE expects that IBEW signatories' wages will at least meet the relevant prevailing wage.

H. SCE's AB 1082 and 1083 Pilots Will Require the Site Hosts to Participate in a Time-Variant Electric Rate for the Charging Station[119]

The customer of record (e.g., site host, EVSP) will be required to take service on one of SCE's time-differentiated rates, but the customer of record will have flexibility to set pricing and parking restrictions for drivers charging at its site. Additional details can be found in Sections III.A.2 and III.C.2.

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117 *See* Cal. Pub. Util. Code § 740.13(f); Cal. Pub. Util. Code § 740.14(c).

118 Studies have found Statewide economic growth and employment rise with the degree and scope of EV adoption. *See* David Roland-Holst, *Plug-in Electric Vehicle Deployment in California: An Economic Assessment* (Sep. 2012), *available at* https://are.berkeley.edu/~dwrh/CERES_Web/Docs/ETC_PEV_RH_Final120920.pdf. *See also* Marc Melaina et al., *National Economic Value Assessment of Plug-in Electric Vehicles*, National Renewable Energy Laboratory (Dec. 2016), *available at* http://www.nrel.gov/docs/fy17osti/66980.pdf.

119 *See* Cal. Pub. Util. Code § 740.13(g); Cal. Pub. Util. Code § 740.14(d).

I. SCE's AB 1082 and 1083 Pilots Will Prioritize Sites Located in or Serving Residents of Disadvantaged Communities.[120]

SCE will prioritize sites located in DACs as detailed in Section III.A and Section III.B.

J. SCE's AB 1082 and 1083 Pilots Avoid Long-Term Stranded Assets.

SCE's pilots avoid long-term stranded assets regardless of the ownership choice pursued by customers in each Pilot. For school sites where the customer chooses to own the charging stations or the infrastructure on the site, SCE will require the site host to procure, install and maintain charging stations in good working order for eight years after the initial installation.[121] Customers will also be responsible for any charging station and installation costs exceeding available rebates and for all energy costs if they choose to own charging stations on their site.

Beyond these Pilot commitment periods, the customer will have the option to remove the charging stations. If the customer wishes to remove charging stations before the Pilot commitment period has finished, it will be required to reimburse the prorated cost of infrastructure deployed through the Pilot. The portion of the costs subject to recovery will be prorated over the required participation period.[122]

For all sites, the risk of technology obsolescence is mitigated because the make-ready infrastructure being installed can support a variety current and future charging technologies. SCE will additionally monitor the load for the electric infrastructure deployed through the Pilots to assess infrastructure usefulness.

K. SCE's AB 1082 and 1083 Pilots Include Significant Outreach.

Prior to filing the AB 1082 Pilot application, SCE, PG&E, and SDG&E held a conference coordinated through the State Department of Education to gather reaction and feedback from school

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[120] *See* Cal. Pub. Util. Code § 740.13(h); Cal. Pub. Util. Code § 740.14(e).

[121] After a school district, county office of education, private school, or other educational institution has participated in the program for eight years, the school district, county office of education, private school, or other educational institution may cease participation in the pilot program and request removal of the charging station by providing 180-day notice to the electrical corporation. Cal. Pub. Util. Code § 740.13(i).

[122] AB 1082 prorated period is 8 years. AB 1083 prorated period is 5 years.

districts. SCE's Business Customer Division also solicited feedback from several schools and school districts. Additionally, SCE leveraged feedback and data gathered during from schools during the Charge Ready Pilot.

To help inform the AB 1083 Pilot application, SCE communicated with the California Department of Parks and Recreation and held multiple in-person and online meetings with individual State Parks located in SCE territory. The State Park Districts provided survey responses that SCE used to size and design the proposal. In addition to this research targeted at potential Pilot participants, SCE coordinated closely with PG&E, SDG&E, and Liberty Utilities to discuss application design and coordination. Finally, SCE consulted with and gathered input from CEC, CARB, and CPUC, and presented twice to the TE Advisory Board.

If the proposed Pilots are approved, SCE account managers assigned to school districts and State Park Districts will engage with customers and educate them on the Pilots to help determine potential sites that would meet Pilot requirements. Account managers will be assigned to high-potential unassigned customers to assist them with their Pilot applications. Additionally, SCE will leverage contact lists gathered through the Charge Ready Pilot and the initial outreach described above. Such activities would potentially include site visits to help identify ideal sites.

L. SCE's AB 1082 and 1083 Pilots Provide Anonymous and Aggregated Data for Evaluation.

The proposed AB 1082 and 1083 Pilots include, among other things, the following elements for each Pilot, as described in the Pilot-specific testimony: objective, scope, cost, estimated duration, and anticipated benefits. These elements provide the foundation for measurable monitoring and evaluation criteria. In addition, SCE also proposes to report on a number of metrics related to implementation and execution. For further details on reporting, see the subsections on data collection and reporting for each of the Pilots.

SCE plans to provide Pilot updates that include anonymous and aggregated data to the Commission and interested stakeholders during regular TE Advisory Board meetings. SCE also proposes to provide a final close-out report after the AB 1082 and 1083 Pilots conclude. These updates

and final close-out report will inform future Commission policy and help guide the design of future utility EV-related programs.

M. Participating Customers Will be Required to Participate in a Demand Response Program.

The customer of record (e.g., site host, EVSP) will be required to take service on one of SCE's time-differentiated rates, site hosts will have will have flexibility to set pricing and parking restrictions for drivers charging at their site. Through TOU rates, drivers are encouraged to charge their vehicles when grid conditions are optimal, minimizing daily load impacts to the grid. SCE will encourage participating customers to pass SCE's TOU rate through directly to drivers, but participating customers may elect to implement their own pricing plans. SCE will also require customers of record to report prices charged to drivers. Regardless of the customer's billing selection, participating customers will be required to participate in a demand response program.[123] SCE will use DR to manage load impacts to the grid by sending out charging control signals to each networked site. Additionally, SCE's AB 1083 Pilot will serve remote locations with minimal or non-existing grid services. To enable charging at these sites, SCE is exploring deploying solar- and battery-based charging stations. In cases where this technology is used to supplement existing grid resources, SCE will use energy management services or software to minimize grid impact while maximizing charge available to the driving public. SCE will provide aggregate information to its TE Advisory Board. SCE will work to educate participating customers to ensure that end-use pricing is easy for drivers to understand and provides the opportunity for drivers to access electricity that is less costly than gasoline while meeting the needs of participating customers.

N. SCE's AB 1082 and 1083 Pilots Leverage Non-Utility Funding.

SCE's Pilots provide funding for make-ready infrastructure and charging station rebates, which will complement public funding targeting the incremental cost of electrifying vehicles and support acceleration of transportation electrification by mitigating cost barriers to adoption.[124]

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[123] *See* Section III.A.2.e.6

[124] *See* Section II.D.

O. SCE's AB 1082 and 1083 Pilots Promote Safety.

SCE is committed to the safety of the public and its employees. SCE's AB 1082 and 1083 Pilots promote customer and worker safety. For instance, the proposed Pilots provide financial incentives to pay for make-ready infrastructure installed by properly qualified, licensed electrical contractors, as well as for the applicable permits, which promote proper safety practices. SCE make-ready infrastructure in the AB 1082 and 1083 Pilots that is not performed by SCE employees will be performed by a contractor signatory to the IBEW holding a valid C-10 contractor's license and EVITP certification. SCE will also leverage the expertise of its Advanced Technology Lab to test new charging technologies and coordinate with external testing agencies to evaluate charging equipment for eligibility in the programs in order to ensure safe connection to and use on the grid. SCE, along with the PG&E and SDG&E, participated in review of the draft Safety Requirements Checklist developed for the SB 350 priority-review transportation electrification projects. If and when the Safety Requirement Checklist is finalized, SCE will adhere to those requirements to the extent feasible.

V.

COST RECOVERY

This section presents SCE's ratemaking proposal for the AB 1082 and 1083 Pilots. SCE requests approval to recover the revenue requirements associated with no more than $19.77 million (2018$) in direct capital expenditures and O&M expenses related to the AB 1082 and 1083 Pilots, including marketing, education, and outreach. SCE also proposes to separately record the AB 1082 and 1083 Pilots incremental revenue requirements in its existing Charge Ready Program Balancing Account ("CRPBA") to provide for the recovery of AB 1082 and 1083 Pilots revenue requirements associated with all recorded AB 1082 and 1083 Pilots-related costs, effective upon a Commission decision in this Application proceeding. Because the Commission will perform a full review of the scope of AB 1082 and 1083 Pilots activities and the forecast costs in this proceeding, reasonableness review of the CRPBA should be limited to a review to ensure that all entries to the account are stated correctly and are associated with AB 1082 and 1083 Pilots activities as defined and approved by the Commission. In addition to a detailed description of the CRPBA and proposed reasonableness standards, this chapter also presents a two-year forecast of AB 1082 and 1083 Pilots revenue requirements. The cost details that are the basis for SCE's revenue requirements forecast are shown below.

Table V-8
Forecast 2019-2021 AB 1082 Pilot Direct Costs
(Millions, 2018 $, excludes escalation and loaders)

Capital Expenditures (Millions of Constant Dollars)	2019	2020	2021	Total
Capital				
Utility-side Infrastructure	$ 0.01	$ 0.74	$ 0.74	$ 1.50
Contingency	$ -	$ 0.07	$ 0.07	$ 0.14
Customer-side Infrastructure	$ 0.01	$ 2.69	$ 2.69	$ 5.38
Contingency	$ -	$ 0.21	$ 0.21	$ 0.43
Portable Units	$ -	$ -	$ -	$ -
Total Capital	**$ 0.02**	**$ 3.71**	**$ 3.71**	**$ 7.45**
O&M				
Labor	$ 0.17	$ 0.36	$ 0.27	$ 0.79
Non-Labor	$ -	$ 0.15	$ 0.29	$ 0.43
ME&O and Other Non-Labor	$ 0.23	$ 0.69	$ 0.30	$ 1.21
Total O&M	**$ 0.40**	**$ 1.19**	**$ 0.85**	**$ 2.44**
Total Capital & O&M	**$ 0.42**	**$ 4.90**	**$ 4.56**	**$ 9.89**

Table V-9
Forecast 2019-2021 AB 1083 Pilot Direct Costs
(Millions, 2018 $, excludes escalation and loaders)

Capital Expenditures (Millions of Constant Dollars)	2019	2020	2021	Total
Capital				
Utility-side Infrastructure	$ 0.01	$ 0.89	$ 0.89	$ 1.79
Contingency	$ -	$ 0.08	$ 0.08	$ 0.17
Customer-side Infrastructure	$ 0.01	$ 1.86	$ 1.86	$ 3.73
Contingency	$ -	$ 0.13	$ 0.13	$ 0.26
Portable Units	$ -	$ 0.49	$ 0.49	$ 0.98
Total Capital	**$ 0.02**	**$ 3.45**	**$ 3.45**	**$ 6.93**
O&M				
Labor	$ 0.17	$ 0.34	$ 0.25	$ 0.76
Non-Labor	$ -	$ 0.08	$ 0.14	$ 0.21
ME&O and Other Non-Labor	$ 0.15	$ 0.93	$ 0.92	$ 1.99
Total O&M	**$ 0.31**	**$ 1.34**	**$ 1.30**	**$ 2.96**
Total Capital & O&M	**$ 0.34**	**$ 4.79**	**$ 4.75**	**$ 9.88**

A. Description of Charge Ready Program Balancing Account

On January 14, 2016, the Commission issued D.16-01-023,[125] which adopted SCE's proposal to establish a Charge Ready Program balancing account to recover the revenue requirements associated with up to $22 million (in 2014 dollars) in direct capital and O&M costs to implement the Charge Ready Pilot. On March 5, 2018, SCE filed a Petition for Modification of D.16-01-023 to allow SCE to recover an additional $22 million in Charge Ready Pilot bridge funding.

On June 26, 2018, SCE filed A.18-06-015 with the Commission requesting approval to increase rates for Phase 2 of its Charge Ready and Market Education Programs (Charge Ready 2). SCE is seeking a total $760.1 million for costs associated with Charge Ready 2. As part of its request, SCE proposed to establish a separate subaccount in its existing CRPBA to record the actual O&M, payroll taxes, and capital-related revenue requirement (*e.g.*, depreciation, return on rate base, property taxes, and income taxes) related to no more than $760.1 million in direct Charge Ready 2 costs.

SCE herein requests Commission authorization to record the actual AB 1082 and 1083 Pilots revenue requirements each month in a separate subaccount in the CRPBA. SCE will record the actual O&M, payroll taxes, and capital-related revenue requirement (*e.g.*, depreciation, return on rate base, property taxes, and income taxes) in the AB 1082 Pilot subaccount and the 1083 Pilot subaccount of the CRPBA.

To ensure timely recovery, SCE requests authorization to transfer the revenue requirement recorded in the CRPBA to the distribution sub-account of the Base Revenue Requirement Balancing Account ("BRRBA") at the end of each year. All revenue requirements associated with expenditures related to AB 1082 and 1083 Pilots below the cap of $19.77 million (2018$, direct spend) that are recorded in the BRRBA as of year-end will be recovered from customers through distribution rates in the subsequent year. SCE will not record any revenue requirements related to AB 1082 and 1083 Pilots expenditures exceeding the $19.77 million (2018$, direct spend) cap in the CRPBA.

Each month, SCE will record in the CRPBA AB 1082 and 1083 subaccounts:

[125] Advice Letter 3362-E, which established the CRPBA, was made effective by the Energy Division on February 11, 2016.

- Capital-related revenue requirements (debit), including depreciation, return on rate base, property taxes, and income taxes based on recorded capital additions and rate base;
- Recorded incremental O&M costs (debit); and
- AB 1082 and 1083 Pilot-related marketing and education costs.

Included in the $19.77 million (2018$, direct spend) AB 1082 and 1083 Pilot caps, SCE proposes to record O&M expense of $5.40 million (2018$) in the CRPBA related to SCE pilot office labor, customer service labor, vendors, ownership and operation O&M, rebates and AB 1082 and 1083 Pilot-related marketing expense.

All recorded incremental costs will include provisions for overhead loadings on direct labor dollars, to account for items such as benefits and payroll taxes.[126] In addition, interest expense will accrue each month in the CRPBA at the three-month commercial paper rate until the year-end transfer of the CRPBA balance to the BRRBA.

B. Proposed Reasonableness Review of AB 1082 and 1083 Pilot Expenditures

SCE proposes that if the AB 1082 and 1083 Pilots actual direct capital and O&M expenditures are both consistent with the scope and within the cost levels adopted by the Commission, then those expenditures will be deemed to be reasonable and therefore no further after-the-fact reasonableness review will be required.

Pursuant to the Commission-adopted process for reviewing other SCE balancing accounts, including the CRPBA for the Charge Ready Pilot and the Transportation Electrification Portfolio Balancing Account ("TEPBA"), SCE proposes that the recorded operation of the CRPBA AB 1082 and 1083 Pilot subaccounts be reviewed by the Commission in SCE's annual April 1 ERRA Review Application. This continuing review of the CRPBA for AB 1082 and 1083 Pilot activity in the ERRA Review proceeding will ensure that all entries to the account are stated correctly and are consistent with

[126] Overhead loading factors will be based on authorized rates. The revenue requirements presented herein reflect all SCE labor loadings. However, to the extent a particular labor loading is currently accounted for in another balancing account (e.g., Pensions, Post-Employment Benefits Other Than Pensions ("PBOPS"), Medical, Dental and Vision), SCE will not include these labor loadings in the recorded operation of the CRPBA.

Commission decisions. Commission review procedures for AB 1082 and 1083 Pilot costs should be limited to ensuring that all recorded costs are associated with activities as defined and adopted by the Commission in this proceeding.

C. Cost Deflation and Reasonableness Determination

Because actual O&M expenses and direct capital expenditures[127] will be recorded in nominal dollars over two years of Pilot spend, these costs will have to be deflated for price inflation between 2018 and later years to allow for comparison to the requested costs shown in Tables V-7 and V-8 above. SCE proposes to accomplish this by deflating the recorded capital and O&M costs by the same inflation indexes used to escalate costs from 2018 levels to nominal dollars used in forecasting. SCE proposes to use two deflation factors: the Handy-Whitman Capital Cost Index for capital and IHS Markit (formerly IHS Global Insight) Electric O&M A&G cost index for O&M. In the annual April 1 ERRA Review proceeding, SCE will seek review of the operation of the CRPBA, and, following completion of the second year of the AB 1082 and 1083 Pilots, SCE will include testimony demonstrating that these expenditures did not exceed authorized amounts. SCE will use the actual, published inflation indexes to deflate recorded costs back to 2018 dollar levels to compare actual O&M expenses and direct capital expenditures to the forecast spend.

D. Forecast of SCE's AB 1082 and 1083 Pilots Revenue Requirements

Table V-10 below presents SCE's forecast 2019-2021 revenue requirements for the AB 1082 and 1083 Pilots.

[127] Direct capital expenditures refers to project-related spend, controllable by program managers, and does not include AFUDC or corporate overheads.

Table V-10
Forecast 2019-2021 AB 1082 and 1083 Pilots Revenue Requirements
(in Millions of Nominal Dollars)

Revenue Requirement (in Millions of Nominal Dollars)					
		2019	2020	2021	Total
1.	O&M	$ 0.85	$ 2.91	$ 2.50	$ 6.27
2.	Franchise Fees and Uncollectibles	$ 0.01	$ 0.04	$ 0.05	$ 0.10
3.	Depreciation	$ 0.00	$ 0.20	$ 0.59	$ 0.79
4.	Taxes	$ 0.03	$ 0.14	$ 0.32	$ 0.49
5.	Return	$ 0.00	$ 0.32	$ 0.95	$ 1.27
6.	Total Revenue Requirement	$ 0.89	$ 3.61	$ 4.41	$ 8.92

Beginning in 2020, SCE requests to include in distribution rates a forecast AB 1082 and 1083 Pilots revenue requirement for each year up until the time these revenue requirements are included in SCE's General Rate Case ("GRC") request (*e.g.*, the 2024 GRC).

SCE currently files an advice letter each year to determine the Charge Ready Pilot revenue requirement to be included in distribution rates the following year. SCE proposes to include the AB 1082 and 1083 Pilots forecast revenue requirement in this same advice letter [128] to be filed in November of each year beginning in November 2019. In the annual advice letters, SCE will update the AB 1082 and 1083 Pilots revenue requirements to reflect the prior year recorded capital expenditures, any forecast capital expenditure changes in the following year, and also the most recently adopted rate of return on rate base, franchise fees and uncollectible rates, and tax rates. SCE will then consolidate the changes in its distribution rates to reflect these updated AB 1082 and 1083 Pilots revenue requirements in conjunction with other authorized rate level changes in its January 1 consolidated revenue requirement and rate change advice letter.

[128] In one advice letter, SCE intends to seek approval to include in rates for the following year a forecast of revenue requirements for the Charge Ready Pilot, Charge Ready 2 (when adopted by the Commission), and AB 1082 and 1083 Pilots, as well as the revenue requirements for the Transportation Electrification Program Priority Review Projects and the Standard Review Project consistent with Section 6.4 in D.18-01-024 approving SCE's Priority Review Projects and Section 8.4 of D.18-05-040 approving SCE's Standard Review Project.

1. Capital Expenditures and Additions

SCE's forecasted revenue requirement as shown in Table V-10, above were derived based on estimated direct capital expenditures of $14.37 million (2018$), as supported in Section III-3 and III-5, above. Table V-11, below shows estimated direct capital expenditures escalated for each calendar year. The total estimated nominal expenditures of $15.55 million are forecast to close to plant-in-service as the assets are placed in service.

Table V-11
Forecast 2019-2021 AB 1082 and 1083 Pilots Capital Expenditures
(in Millions of Nominal Dollars)

Capital Expenditures (Millions of Nominal Dollars)	2019	2020	2021	Total
Capital				
Utility-side Infrastructure	$ 0.02	$ 1.74	$ 1.79	$ 3.55
Contingency	$ -	$ 0.16	$ 0.17	$ 0.33
Customer-side Infrastructure	$ 0.02	$ 4.85	$ 4.99	$ 9.86
Contingency	$ -	$ 0.37	$ 0.38	$ 0.75
Portable Units	$ -	$ 0.52	$ 0.54	$ 1.05
Total Capital	**$ 0.05**	**$ 7.64**	**$ 7.87**	**$ 15.55**

a) Capital Additions and Plant-In-Service

Capital expenditures are not included in rate base until the assets are ready for service. The accounting for this is prescribed by the Federal Energy Regulatory Commission ("FERC") Uniform System of Accounts ("USoA"). When incurred, capital expenditures record to FERC Account 107, Construction Work In Progress ("CWIP"). While in CWIP, costs typically accrue capitalized financing costs (known as Allowance for Funds Used During Construction ("AFUDC") at rates based on a prescribed formula in the FERC USoA. Once ready for service, cumulative costs, including AFUDC, are transferred from CWIP to Plant-In-Service[129] as Capital Additions. At this same time, AFUDC accruals are stopped, the cumulative balance is included in rate base, and depreciation expense begins.

For purposes of forecasting capital for the AB 1082 and 1083 Pilots, SCE has assumed that AFUDC accruals will be zero. However, on a recorded basis, the CRPBA will reflect

[129] Plant-In-Service includes FERC Accounts 106 (Completed Construction Not Classified) and 101 (Electric Plant-In-Service.

actual recorded revenue requirements, including all applicable overheads and AFUDC to the extent that they are incurred.

b) Depreciation Expense and Accumulated Depreciation

Line 3 of Table V-11 shows forecast total annual depreciation expense of $0.79 million over the 2019 – 2021 period. To estimate annual depreciation expense capital additions were divided into (1) utility-side infrastructure including line transformers, services, meters, and easements, (2) customer-side infrastructure that includes the panel, conduit, wiring, and "make-ready" stub, and (3) the solar- and battery-based charging stations. Depreciation for utility-side infrastructure uses a composite[130] 3.40 percent rate as authorized in SCE's 2015 GRC. Depreciation rates for customer-side infrastructure are estimated using the 4.44 percent authorized rate approved in the decision authorizing SCE's Charge Ready Pilot.[131] Depreciation rates for the solar- and battery-based charging stations is 10% based on the undisputed rate proposal for storage equipment in SCE's currently pending 2018 GRC.

On a recorded basis, SCE will utilize depreciation rates adopted in its Final 2018 GRC Decision. To the extent that certain charging sites are no longer used after the Pilot period, capital recovery for the investment will continue under normal group depreciation procedures.[132]

2. Rate of Return

SCE calculated the return on rate base using SCE's current authorized rate of return of 7.61 percent established in D.17-07-005 and subsequently approved in Advice Letter 3665-E. On a

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[130] This composite is based on recorded plant balances in the Charge Ready Program Balancing Account as of April 2018.

[131] D.16-01-023.

[132] SCE's assets are depreciated using broad group procedure. Generally, a broad group is defined by FERC plant account, with some exceptions. Assets within a broad group are expected to retire before and after the average service life, and by convention, are fully depreciated when retired. Under CPUC Standard Practice U4, the depreciation rate is recalculated on a periodic basis (currently in GRCs) determining the annual accruals necessary to allocate the net book value less future net salvage over the average remaining life of the group. Thus, any over- or under-allocation is addressed in future periods.

recorded basis, SCE will update its rate of return on rate base to be consistent with the then-currently authorized rate of return.

3. O&M Expenses

SCE's forecasted revenue requirements were derived based on the O&M expenses supported in Chapter III.C.1, and summarized in Table III-7 above. O&M labor expenses include all applicable overheads.[133]

4. Income Taxes

SCE estimates income taxes by following the rules and methods adopted in the Company's GRCs. Specifically, in computing tax depreciation, on property owned by SCE, SCE uses the twenty year MACRS ("Modified Accelerated Cost Recovery System") tax life for federal purposes and a thirty-year life, straight-line method, for computing State tax depreciation. Deferred taxes are estimated as required by the normalization rules of the Internal Revenue Code ("IRC") for property owned by SCE that are subject to the MACRS under IRC Section 168. SCE will use flow-through tax treatment on book and State tax depreciation differences, as required by this Commission. SCE computes tax basis by removing any recorded AFUDC and replacing it with the tax capitalized interest following the rules of IRC Section 263A. SCE computes tax expense using the applicable federal corporate tax rate of 21 percent for each year and an apportioned State corporate tax rate as applicable.

[133] The forecast revenue requirements as presented in Table V-7 include a composite benefit loader of 36.91%.

Appendix A

The Clean Power and Electrification Pathway White Paper

SOUTHERN CALIFORNIA EDISON®
Energy for What's Ahead℠

THE CLEAN POWER AND ELECTRIFICATION PATHWAY

Realizing California's Environmental Goals

November 2017

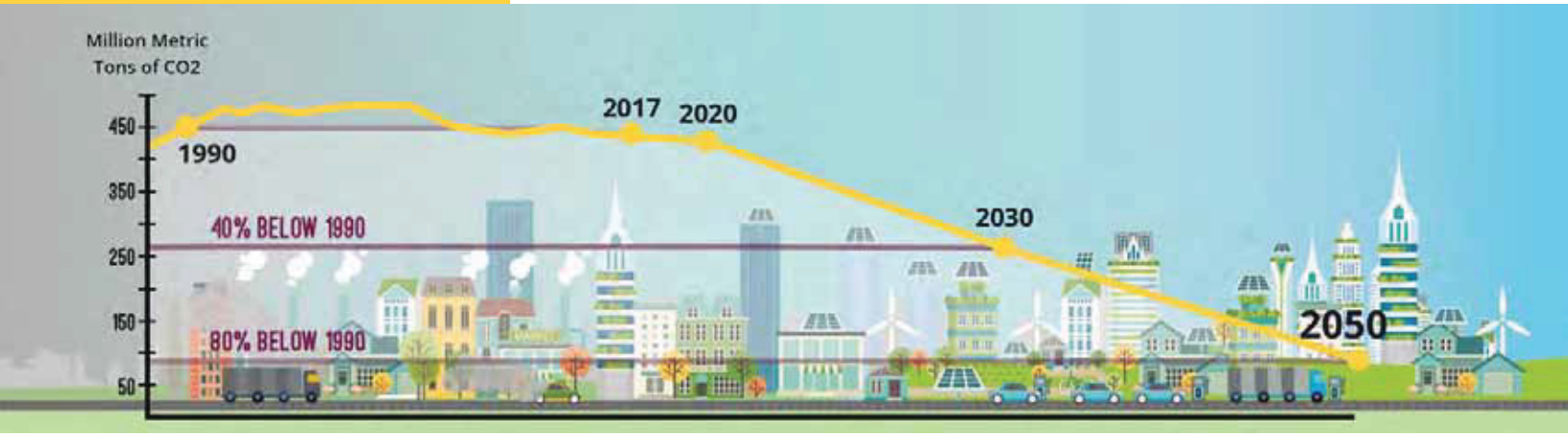


Figure 1: Meeting California's GHG Reduction Goals *(Source: California Air Resources Board [CARB])*

This paper presents Southern California Edison's integrated blueprint for California to reduce greenhouse gas emissions and air pollutants. Realizing the blueprint will reduce the threat of climate change and improve public health related to air quality. It is a systematic approach and each measure is integrated with — and depends upon — the success of the others. To be successful, California must approach implementation as an integrated package, applying resources across the board where most effective.

EXECUTIVE SUMMARY

Climate change and air pollution pose serious threats. Climate change effects, such as sea level rise and longer, more intense heat waves, are now occurring. In California, while significant progress has been made, too many communities continue to experience asthma and other air-quality-related health issues.

California continues its leadership in addressing climate change and air pollution. The state's greenhouse gas (GHG) goals call for a 40 percent reduction in GHG emissions from 1990 levels by 2030 and an 80 percent reduction by 2050 (Figure 1). Air quality goals include a 90 percent reduction in emissions of nitrogen oxides from 2010 levels in some of the state's most polluted areas by 2032. Meeting these ambitious clean energy and clean air goals requires fundamental changes over the next 12 years and beyond.

The electric sector is at the forefront of the fight against climate change in California and today accounts for only 19 percent of the state's GHG emissions. The transportation sector (including fuel refining) and fossil fuels used in space and water heating now produce almost three times as many GHG emissions as the electric sector and more than 80 percent of the air pollution in California.

The Clean Power and Electrification Pathway is an integrated approach to reduce GHG emissions and air pollution by taking action in three California economic sectors: electricity, transportation and buildings. It builds on existing state policies and uses a combination of measures to produce the most cost-effective and feasible path forward among the options studied.

The Pathway will help California achieve its climate goals and significantly reduce today's health-harming air pollution in local communities. It also has strong potential to create highly-skilled, middle-income jobs.

By 2030, it calls for:

- an electric grid supplied by 80 percent carbon-free energy;
- more than 7 million electric vehicles on California roads; and
- using electricity to power nearly one-third of space and water heaters, in increasingly energy-efficient buildings.

(Continued)

(Continued - Executive Summary)

These electrified technologies will use zero-emission resources like solar and wind to provide most of their power, and can in turn support the electric grid by balancing electricity demand with supply.

The private and public sectors must work together to support customer adoption, while ensuring electricity remains reliable and affordable, and that end-use technologies are increasingly energy efficient. Public policy can enable the Clean Power and Electrification Pathway through comprehensive integrated resource planning that includes consideration of end uses of fossil fuels, through investing cap-and-trade revenues thoughtfully, and through supporting electrification in transportation, homes and businesses.

Southern California Edison is proud to be a long-standing partner with the state, customers and our communities on important climate change and air quality efforts. We look forward to continuing this broad-based partnership to pursue practical, cost-effective approaches to achieving a bold, clean energy future.

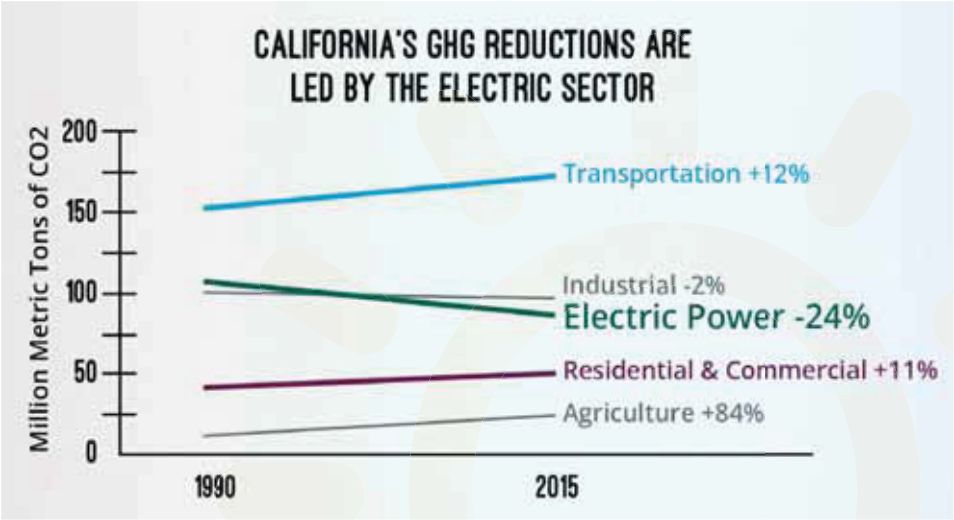


Figure 2: Change in California GHG Emissions *(Source: CARB)*

Successive California policies supporting GHG emissions reductions[1]

1. **SB 1078 (2002), SB 107 (2006), and SB X1-2 (2011)** established a Renewables Portfolio Standard (RPS), 20% by 2010 and then 33% by 2020.
2. **Executive Order S-3-05 (2005)** established a target of reducing GHG emissions 80% below 1990 levels by 2050.
3. **AB 32 (2006)** codified a GHG emissions target of 1990 levels by 2020 and created an economy-wide cap-and-trade program.
4. **SB 350 (2015)** established an RPS of 50% by 2030 and added new requirements for doubling energy efficiency and for wide scale transportation electrification deployment.
5. **SB 32 (2016)** codified a GHG target of reducing emissions 40% below 1990 levels by 2030.
6. **AB 398 (2017)** extended cap-and-trade program to 2030 and defined new offset levels.
7. **CARB Proposed Scoping Plan (2017)** identifies policies and tools to achieve the 2030 GHG target.

Additional major policy measures include the Low Carbon Fuel Standard, the Zero Emission Vehicle Program and Sustainable Community Planning.

A systematic approach that integrates these programs and market activities provides the best chance of achieving shared goals at the lowest cost to customers and the economy.

INTRODUCTION

California is committed to reducing its greenhouse gas (GHG) emissions, improving local air quality and supporting continued economic growth. The state set goals to reduce GHG emissions by 40 percent from 1990 levels by 2030 and 80 percent from the same baseline by 2050 (Figure 1).[2] State and local air quality plans call for substantial improvements, such as reducing smog-causing nitrogen oxides (NOx) 90 percent below 2010 levels by 2032 in the most polluted areas of the state.[3] Meeting environmental goals of this magnitude will require fundamental changes to infrastructure and transportation and, at the same time, can help the California economy by creating jobs. These policy goals cannot be achieved by the electric sector alone.[4]

The Urgency of Meeting Climate Change and Air Quality Goals

Meeting California's pressing 2030 climate and air quality goals requires timely, proactive decision-making by policymakers and leaders throughout the state. Stakeholders must quickly align on the near-term programs and market transformation activities required to meet this ambitious schedule. A systematic approach that integrates these programs and market activities provides the best chance of achieving shared goals at the lowest cost to customers and the economy.

The electric sector has provided the majority of emissions reductions in California (Figure 2) through energy efficiency, the phasing out of coal, and integration of new renewable resources. We are ahead of pace to reach a 50 percent renewables portfolio standard (RPS) by 2030.[5]

For California to meet its 2030 GHG target, significant emission reductions will be required from consumers of liquid and gas fuels — primarily in the transportation and building sectors. The transportation sector contributes nearly 40 percent of California's GHG emissions (approximately 45 percent when oil refining is included) and 80 percent of California's smog-forming NOx emissions.[6] The residential, commercial, and industrial sectors combined contribute approximately 30 percent of the state's GHG emissions (Figure 3). These emissions, as opposed to the emissions from the electric sector, have risen by more than 10 percent since 1990.[7]

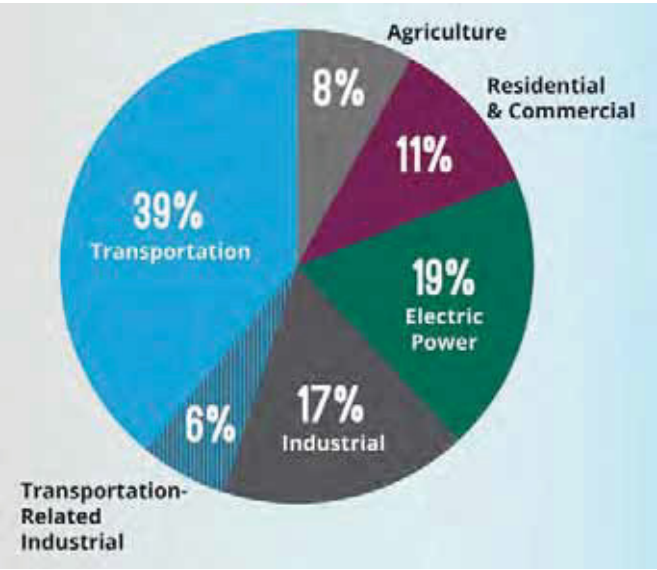


Figure 3: California GHG Emissions by Sector in 2015 *(Source: CARB)*

CLEAN POWER AND ELECTRIFICATION PATHWAY

California has taken concrete steps to move toward a clean energy future. Market-based policies such as the GHG cap-and-trade program and the low-carbon fuel standard provide a solid foundation by putting a price on carbon to encourage the most cost-effective actions to reduce or avoid GHGs. There are multiple pathways to meet California's 2030 climate goals, with varying levels of difficulty and costs. Some pathways are better than others in positioning the state to achieve 2050's deeper carbon reduction goals. SCE explored three alternatives (Table 1) and found that a clean power and electrification path is the most affordable and feasible approach to reaching California's climate and air quality goals. This pathway also will contribute to a strong state economy and can be an engine for creating highly-skilled, middle-income jobs.[8]

Table 1: Comparing 2030 Decarbonization Pathways *(Source: SCE Internal Analysis using E3 Pathways Model. Available at sce.com/pathwayto2030)*

PREFERRED PATHWAY CLEAN POWER AND ELECTRIFICATION	RENEWABLE NATURAL GAS (RNG)	HYDROGEN (H2)
• **80%** carbon-free electricity supported by energy storage • At least **24%** of light-duty vehicles are EVs (7MM) • **15%** of medium-duty and **6%** of heavy-duty vehicles are electrified • **Up to 30%** efficient electrification of commercial and residential space and water heating	• **60%** carbon-free electricity • **24%** of light-duty vehicles are EVs (7MM) • **12%** of medium- and heavy-duty vehicles use compressed natural gas • **42%** of natural gas replaced by RNG	• **80%** carbon-free electricity • **22%** zero-emission light-duty vehicles (4MM H2, 2MM EV) • **4%** of heavy-duty vehicles use H2 • **7%** natural gas replaced by hydrogen
• Dependent on broad adoption of electrified technologies • Most feasible pathway because technology already exists	• Power-to-gas not yet commercially available • A large biogas market requires expensive imports	• Most expensive pathway • Requires significant H2 adoption outside of CA • Lack of sufficient delivery infrastructure
Incremental abatement cost (last 36 MMT)* $79/ton	**Incremental abatement cost (last 36 MMT) $137/ton**	**Incremental abatement cost (last 36 MMT) $262/ton**

*The pathways analyzed include measures to achieve the full 2030 GHG abatement (180 MMT), such as existing state policies and programs included in CARB's Proposed Scoping Plan and additional measures. 36 MMT represents the last 20 percent of GHG abatement needed to meet the 2030 target after offsets are used. This incremental abatement is incentivized by the cap and trade market.

THE VISION FOR CLEAN POWER AND ELECTRIFICATION

The Clean Power and Electrification Pathway…builds on existing state programs and policies to achieve California's climate and air quality goals…

The Clean Power and Electrification Pathway is an integrated approach that builds on existing state programs and policies to achieve California's climate and air quality goals, while ensuring that an economy-wide transformation happens in an efficient and — importantly — affordable way. Using existing technologies, the Pathway calls for an electric grid with more carbon-free energy, which is used to clean other sectors of the economy. As the electric supply becomes cleaner, every electric vehicle and electric space or water heater becomes cleaner over its lifespan.

The Clean Power and Electrification Pathway to 2030 is defined by three measures. Each measure is integrated with — and depends upon — the success of the other and should be pursued in concert:

1. **Continue carbon reduction in the electric sector:** increase energy efficiency, provide 80 percent carbon-free energy through large-scale resources and use distributed solar.
2. **Accelerate electrification of the transportation sector**, including placing at least 7 million light-duty passenger vehicles on the roads and supporting a transition to zero-emission trucks and transit.
3. **Increase electrification of buildings:** electrify nearly one-third of residential and commercial space and water heaters.

Continue Carbon Reduction in the Electric Sector

Electric sector measures, including providing 80 percent carbon-free energy from large-scale resources, and leveraging energy efficiency and distributed solar will lower GHG emissions from 84 to 28 million metric tons (MMT)/year (Figure 4). This represents 31 percent of the 2030 GHG reduction goal and aligns with California's pillars for carbon reduction and decades of state energy policy.[9]

Large-scale renewable energy is likely to be the most significant and affordable means of decarbonizing the electric supply. The transmission grid can provide 80 percent carbon-free energy from a combination of renewable resources including wind, solar and large hydroelectric

Figure 4: GHG Reductions Across Sectors to Reach 2030 Goals

generators. This will require the development of up to 30 gigawatts (GW) of additional renewable capacity.

California's electric system can incorporate a high penetration of large-scale renewable resources by having a renewables portfolio that is diverse in geography and resource availability, increasing transmission capacity, and enhancing integration across the western grid.

Using a system that relies so heavily on variable resources like wind and solar will require up to 10 additional GW of energy storage from fixed and mobile sources to even out hourly, daily and seasonal energy imbalances (the differences between energy supply and usage).

Even at today's levels of renewables, these energy imbalances can result in California's infamous "duck curve" — the timing imbalance that exists between solar generation and daily peak load.[10] This creates two significant problems for today's electric grid:

- the excess supply of solar at midday, which can lead to shutting down large-scale renewable resources or paying other states to take our power; and
- the significant fast ramp-up in generation to reliably cover the late afternoon and evening electricity need as the sun sets, solar generation fades and customer energy demands peak.

The extremes of the duck curve can be mitigated by the addition of energy storage at scale. Flexible electric vehicle charging could also provide beneficial load shifting — effectively a form of mobile energy storage — that could make electric fueling more affordable. Nonetheless, the magnitude of the duck curve issues is expected to increase as more renewables are added to the system, and some amount of gas-fired generation will be needed for service reliability.

Modernizing the distribution grid with available and evolving technologies will...support our customers' desire to participate in the clean energy future by making their own energy choices.

Reducing or avoiding carbon in the electric sector also requires advances to integrate the clean energy resources that customers are adopting. These resources on the distribution grid are expected to include increased energy efficiency (consistent with SB350's mandate to double energy efficiency), rooftop and community solar, and electric vehicles. Modernizing the distribution grid with available and evolving technologies will allow these distributed energy resources to be better integrated and optimized, will improve system reliability and safety, and will support our customers' desire to participate in the clean energy future by making their own energy choices.

Accelerate Electrification of the Transportation Sector

The GHG reduction potential of the Clean Power and Electrification Pathway hinges on aggressive electrification of light-duty vehicles, i.e., the passenger cars, SUVs and pickup trucks that currently contribute one-quarter of California's GHG emissions.[11] The Pathway calls for at least 24 percent of these vehicles — 7 million — to be electrified by 2030. EVs charging from an increasingly clean electric grid can help reduce transportation sector GHG emissions from 169 to 111 MMT/year, one-third of the 2030 goal. Reduced gasoline demand will also provide the benefit of reducing industrial emissions from refineries.

Electrification of the transportation sector will greatly improve local air quality — an urgent community need across California and particularly

Expanding transportation electrification will require sustainable policies and collaboration between vehicle manufacturers, charging companies, policymakers and electric utilities on issues such as charging standards and consumer awareness.

in Southern California. Many communities, particularly DACs*, are situated near heavily traveled freight corridors, where the concentration of air pollutants often exceeds health-based standards.†

Medium- and heavy-duty vehicles contribute to GHG emissions and are the largest mobile source of smog-forming emissions across the state. The Pathway calls for electrifying 15 percent of medium-duty and 6 percent of heavy-duty vehicles in the state by 2030, supporting needed GHG reductions and improvements in air quality. This will help California position itself for the 2050 GHG goal, which will require the elimination of virtually all vehicle emissions from fossil fuels.[12]

While these vehicle growth targets are ambitious, they are not far outside forecasts of rapid growth in the EV market.[13] Growing customer interest, increasing availability and variety of EV models (Figure 5), and the favorable economics of using EVs for ridesharing and autonomous vehicles have made a high-EV future more plausible than ever. Nations such as the United Kingdom, France, Norway, India and China have announced plans to phase out internal combustion vehicles within coming decades. Manufacturers are responding; GM recently indicated that it expects the company's entire model lineup to run on electricity in the future, and Volvo committed to eliminating traditional internal combustion engines in favor of an electric and hybrid fleet as early as 2019.[14]

Expanding transportation electrification will require sustainable policies and collaboration between vehicle manufacturers, charging companies, policymakers and electric utilities on issues such as charging standards and consumer awareness.[15]

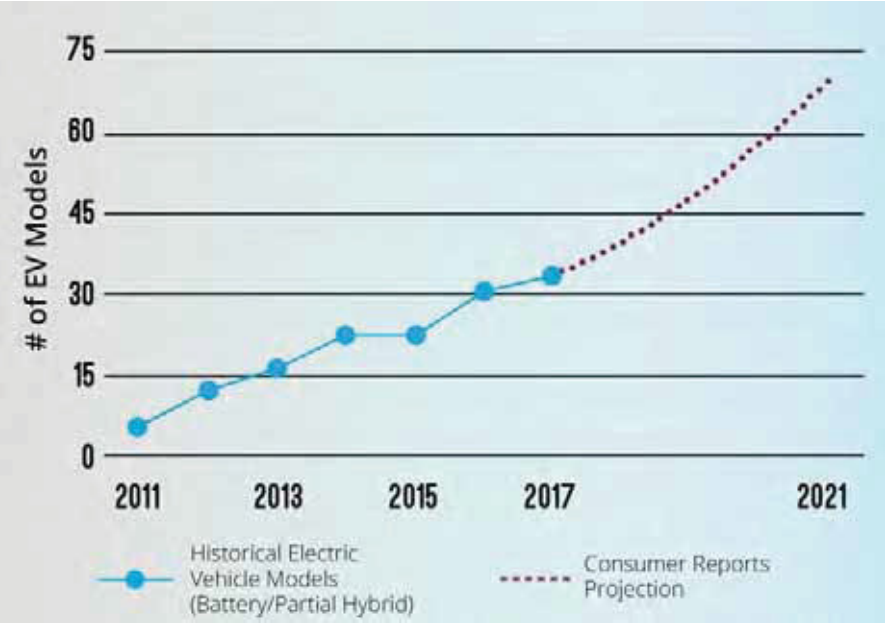


Figure 5: Battery/Partial Hybrid Electric Vehicle Models
(Sources: U.S. Department of Energy/Consumer Reports)

*CalEPA uses the designation Disadvantaged Community (DAC); DACs represent the 25% highest scoring census tracts in CalEnviroScreen 3.0, along with other areas with high amounts of pollution and low income populations.
†Electrification in areas such as the I 710 corridor between Long Beach and Los Angeles promotes environmental justice by insuring that climate investments provide near term air quality benefits to a broad set of communities.

Current codes and standards are based on the 20th century power-generation supply framework dominated by fossil fuels.

Continued price incentives, funded by the cap-and-trade and low carbon fuel standard programs, help to lower up-front purchase costs and will help drive additional adoption, as will increased selection and EV availability.

In order to support at least 7 million electric cars by 2030, California will need to have over one million away-from-home charging ports.[16] The state's investor-owned and public utilities have initiated charging infrastructure pilots*[17], but these pilots alone will not meet the expected scale of light-duty EV adoption. Funding will be needed to enable utilities and charging companies to rapidly deploy more infrastructure and chargers.

For medium- and heavy-duty vehicles in urban areas with lower daily mileage, such as buses, delivery vehicles and intermodal freight trucks, electrification is already being deployed and can significantly reduce GHG emissions and improve air quality. Larger plug-in electric and plug-in hybrid electric trucks are in development[18] and will play a greater role in achieving California's 2050 climate and air quality goals. Early deployments must coincide with the development of adequate charging infrastructure to support this critical clean-transportation opportunity.

Increase Electrification of Buildings

Space and water heating currently contributes more than two-thirds of total residential and commercial building GHG emissions. Electrifying nearly one-third of residential and commercial space and water heaters, in addition to increased energy efficiency and strong building codes and standards, could reduce GHG emissions from this sector from 49 to 37 MMT/year, or 7 percent of the 2030 goal.

Expanding electrification of residential and commercial buildings will require new policies and support. Collaboration between manufacturers, repair service providers and policymakers is needed to raise awareness and increase availability of clean, efficient options for electric space and water heating in new building construction and retrofits. Current building codes and standards are based on the 20th-century framework of power generation supply dominated by fossil fuels. This framework should be updated to account for an increasingly decarbonized electric grid.

Updated codes and standards can advance the use of clean electric appliances in new buildings, and incentives can encourage adoption of clean technologies through appliance replacement. For instance, controllable electric space and water heating, which draws from carbon-free electricity powered by solar in the middle of the day, could be an evolution of the Zero Net Energy (ZNE) framework toward more carbon-focused principles for new home construction.[19]

REACHING OUR GOALS WITHIN 12 YEARS

While the Clean Energy and Electrification Pathway is feasible, meeting the 2030 climate goal and also achieving significant improvements in air quality is an urgent challenge, requiring focused efforts and purposeful actions across multiple sectors of the economy (Figure 6). Many of the needed approvals, programs, and market transformations require compromise and consensus among stakeholders with diverse agendas and priorities. Customer adoption is also key to success — and that adoption requires that electricity remains an affordable alternative to fossil fuels.

*For instance, SCE's Charge Ready program is a $22 million pilot to increase charging infrastructure throughout the SCE service territory. The program provides the electrical infrastructure necessary for EV charging, as well as rebates to help pay for charging stations.

SCE's Clean Power and Electrification Pathway calls for integrated actions, programs and policies across all sectors of the economy and strongly links grid decarbonization with electrification right from the start. Planning for 2030 reduction targets now provides a starting point for important, necessary policies, programs and actions needed to meet the even more transformational 2050 climate goals.

Putting millions of electric vehicles on California's roads requires overcoming current barriers, such as vehicle affordability, customer awareness and EV charging accessibility. Durable, predictable incentives that lower EV purchase prices will encourage buyers to choose plug-in models at the end of their gasoline-powered vehicles' 11- year life cycles. Healthier incentives will also be needed to encourage commercial enterprises to switch to electricity as a fuel for buses and delivery and intermodal trucks with 18-year average life spans. In addition, charging station networks will need to expand rapidly to ensure availability at workplaces, multifamily units and along heavily traveled corridors.

An electric system upgrade can take as long as a decade to site, license, build and commission. Planning often involves a consensus-driven process that rarely results in a quick decision. Given this timeline, for the majority of electric power in California to come from renewable and distributed energy resources by 2030, the planning process for additional transmission capacity, new renewable energy development projects, grid modernization and large-scale energy storage investments must start now.

California's Building Energy Efficiency Standards are updated every three years, at the culmination of a multi-year planning process. Development of the 2019 standards is nearing completion, and planning for 2022 standards is an opportunity for strategic discussions. Waiting until the 2025 cycle could cost California the opportunity to decarbonize hundreds of thousands of new homes through electrified space and water heating, at a lower cost than later retrofits.

SUPPORTING THE PATHWAY THROUGH CALIFORNIA POLICY

Integrated Resource Planning

California has begun integrated resource planning — a comprehensive planning process to meet forecasted electricity needs and GHG targets for the electricity sector. Planning a decarbonized grid in a cost-effective manner requires strong coordination and balanced trade-offs for the good of the overall system. Provided that its scope includes consideration of

Figure 6: Planning and Life Cycle Timeline *(Source: SCE Internal Analysis)*

Planning a decarbonized grid in a cost-effective manner requires strong central coordination and balanced trade-offs across many parties for the good of the overall system.

the end uses of fossil fuels, this new process has the potential for more efficient planning decisions across economic sectors and electric sector technologies. This kind of planning would include large-scale and customer-sited renewable resources, energy efficiency, electric vehicles, energy storage and more.

GHG Cap-and-Trade
California's market-based, GHG cap-and-trade program is a critical enabler of the Clean Power and Electrification Pathway. Setting a price on GHG emissions with limited offsets creates opportunities to optimize spending in areas that most cost-effectively reduce or avoid GHG emissions. The continued, direct allocation of emissions allowances to utilities helps ensure electricity remains affordable and competitive with fossil fuels during the transition to the clean energy future.

Market-based programs could be bolstered by new flexible policy tools and significant funding to spur customer choice for clean electrification. California policymakers should allocate additional cap-and-trade revenues to programs that encourage consumers to adopt transportation and building electrification.

Transportation Electrification
New or refreshed policies could be enacted to smooth the pathway to broad customer adoption of electric vehicles. These policies could include support for continued and expanded consumer education, continued incentives for EV purchases, adequate charging infrastructure, and pricing that keeps electric fueling costs competitive with gasoline and diesel. Efforts are also needed to ensure the affordability of, and access to EVs for mid- and low-income Californians.

Building Electrification
California's 2022 Building Energy Efficiency Standards could include establishing new building standards to promote the clean electrification of space and water heating in homes and businesses, as well as to require collecting more data on fossil fuel end uses. In addition, energy efficiency programs could be optimized to include a focus on their ability to support GHG emissions reductions.

Keeping Clean Electricity Affordable
A key consideration for many consumers is, and will remain, the cost of electricity. The success of the Clean Power and Electrification Pathway rests on implementing an integrated package of measures that contribute to a strong California economy and maintain affordable electricity for all customers.

The price of electricity and who pays the costs must reflect the services provided to customers. All users of the electric grid must pay their share to support a reliable and increasingly clean electric system. Policies that ensure this fairness will help to keep electricity affordable, which will support customer adoption of the electrified solutions in the transportation and building sectors.

Creating Jobs That Support the Clean Energy Economy
A clean energy future benefits the California economy. Many studies suggest that the clean energy and electrification measures described in the Pathway will lead to higher statewide gross product, real output, state revenue and employment.[20] Highly skilled, middle-income jobs will be created to introduce and service new technologies. The Clean Power and Electrification Pathway can be a double win — both more prosperous and healthier — for California's residents.

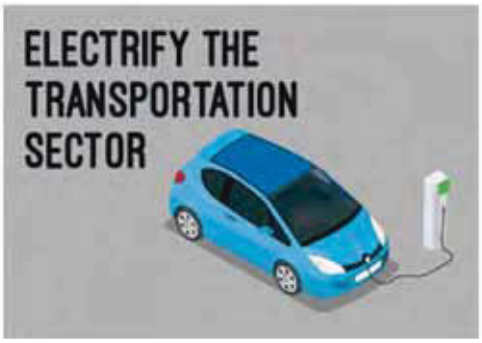
CONCLUSION

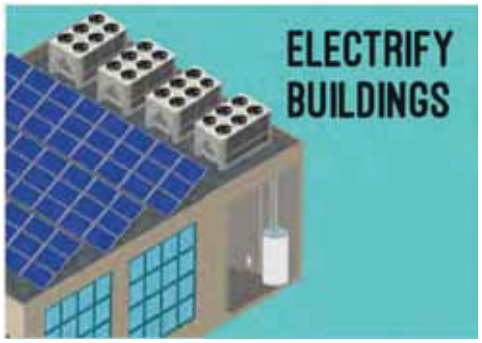
Because of California's size and economic complexity, it will be a major undertaking for the state to meet its GHG goal in just 12 years. It is similarly difficult to meet our air quality targets. As the world's sixth largest economy, California has a unique opportunity to create a blueprint that others can follow for an affordable clean energy economy that improves air quality for our communities and mitigates impacts of climate change through greenhouse gas reductions across all energy sectors: electricity, fuels and gases.

Broad decarbonization and electrification of the economy requires comprehensive policy to guide the transformations across our economy — not just in the electric sector.

Electric utilities are uniquely positioned to facilitate the transformation to a clean energy economy. They have the size, scope and infrastructure assets to deliver clean energy and support electrification for all customers. They also have the capacity to finance prudent investments to maintain and modernize the grid, with regulatory approval. But, they cannot do it alone. Broad decarbonization and electrification of the economy require comprehensive policy to guide the transformations across our economy — not just in the electric sector.

Everyone who lives, works, drives or invests in California is a stakeholder in this effort. The results will be a new energy paradigm that will address the enormous challenge of global climate change through the reduction of GHG emissions, improved air quality and human health — providing access to clean energy for all consumers.





ACRONYMS

AB	Assembly bill (California State Assembly)
BEV	battery powered electric vehicle
CAISO	California Independent System Operator
CARB	California Air Resources Board
CNG	compressed natural gas
EV	electric vehicle
GHG	greenhouse gas
GW	gigawatt
H2	hydrogen
HDV	heavy duty vehicle
MDV	medium duty vehicle
MM	million
MMT	million metric tons
NOx	nitrogen oxide
PHEV	plug in hybrid electric vehicle
RNG	renewable natural gas
RPS	Renewables Portfolio Standard
SB	Senate bill (California State Senate)
SCE	Southern California Edison
ZNE	zero net energy

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Electronic copies of this white paper and its appendices are available at sce.com/pathwayto2030

The Clean Power and Electrification Pathway

Realizing California's Environmental Goals

Appendices

November 2017

Contents

APPENDIX I: Pathway Analysis

Development Approach

The scope of the SCE Pathways Analysis was to identify the most feasible and economical pathway to realizing California's greenhouse gas (GHG) policy target in 2030, reducing emissions from all economic sectors by 180 million metric tons (MMT) from 440 MMT in 2015 to 260 MMT in 2030 and reducing air pollution to support achievement of health-based air quality standards.

The analysis resulted in the development of the Clean Power and Electrification Pathway. The Pathway includes the 132 MMT[1] of GHG abatement from the California Air Resources Board (CARB) Proposed Scoping Plan, in addition to 12 MMT of abatement obligations projected to be met by cap-and-trade offsets (4 percent of CARB's allotment for 2030). (See **Table 1.**) The GHG abatement from most of the current and expected policies identified in the CARB Proposed Scoping Plan are listed in **Table 2**.

Table 1. California GHG Accounting from CARB Policy

	GHG Accounting
2015 California Emissions (Economy Wide)	**440 MMT**
CARB Scoping Plan Update 2017	(132 MMT)
Cap-and-Trade Offsets	(12 MMT)
Cap-and-Trade Market / Incremental Abatement	(36 MMT)
2030 Emissions Target (40% below 1990 levels)	**260 MMT**

SCE used four criteria to select the GHG abatement measures for the Clean Power and Electrification Pathway (see **Table 3**) to abate the remaining 36 MMT needed to reach the 2030 GHG goal:

1. GHG abatement potential;
2. Marginal abatement costs[2];
3. Measure feasibility (availability of technology, infrastructure requirements, economies of scale, consumer preference, timing of deployment); and
4. Technologies that will continue to support GHG reductions beyond 2030 and help California achieve the 2050 GHG target (i.e., technologies with low risk of stranded investment by 2050).

The analysis to develop the Clean Power and Electrification Pathway, and alternative pathways, details the combination of measures (**see Table 4**) that could be implemented to achieve the 36 MMT of incremental abatement, incented by cap-and-trade.

This analysis used the Energy + Environmental Economics (E3) PATHWAYS model for deep decarbonization scenarios (https://www.ethree.com/tools/pathways-model/), as well as internally-developed economic adoption and renewable generation optimization models. These models produced an economy-wide view of the expected GHG abatement from existing and expected policies and forecasted economic adoption of low-carbon technologies and fuels. Results are in **Table 5**.

[1] The CARB Proposed Scoping Plan calls for a number of initiatives and policies that would achieve 135 MMT of GHG abatement. However, AB 398 (2017) removed refinery efficiency improvements, accounting for 3 MMT of abatement. AB 398 also authorized the use of offsets to account for up to 12 MMT of emissions abatement.

[2] Marginal abatement costs refer to the cost of an additional unit of abatement, whereas incremental costs in this appendix refer to the cost of abating the final 36 MMT of GHG to meet California's 2030 climate goals.

Table 2. CARB Identified Policy Impacts by Sector

Sectors	Initiatives and Policies	High-Level Description of Key Elements
Transportation	Low Carbon Fuel Standard	- 18% reduction in carbon intensity in fuel by 2030
	Mobile Source Strategy	- 1.5 million light-duty Zero Emission Vehicles (ZEV*) and Plug-in Hybrid Electric Vehicles (PHEV) by 2025 and 4.2 million ZEVs by 2030 - Medium- and heavy-duty GHG Phase 1 and 2 to reduce new vehicle emissions by 4 to 5% per year starting 2014 - Advanced Clean Transit: starting in 2018, 20% of new buses sold must be zero emission, increasing to 100% in 2030 - Last Mile Delivery: requirement to purchase low-NOx engines and phase-in zero emission trucks starting in 2020
	SB 375 Sustainable Community Strategies and Climate Protection Act of 2008	- Reduce Vehicle Miles Traveled (VMT) through greater access to alternative forms of transportation
	California Sustainable Freight Action Plan	- Improve freight system efficiency by 25% by 2030 - Deploy >100,000 freight vehicles and equipment capable of zero emission operation and maximize near-zero emission freight vehicles and equipment powered by renewable energy by 2030
	CARB Advanced Clean Cars	- By 2025, new vehicles will emit 75% less smog-forming pollutants and about one-half the GHG of the average new car sold today - Beyond 2025, 5% additional GHG emissions reductions are projected through new vehicle emissions standards - Zero Emission Vehicle Regulation requires ~15% of new cars sold in CA in 2025 to be PHEV, battery electric vehicles (BEV) or fuel cell vehicles
	Alternative Transportation	- Large Scale High Speed Rail
	Caltrans Complete Streets Implementation Action Plan	- Sustainable transportation facility for all users in rural, suburban, and urban areas
Electric Power	SB 350	- Increase the Renewables Portfolio Standard (RPS) to 50% by 2030 - Double additional achievable energy efficiency in electricity and natural gas end uses by 2030
	CPUC Rulemaking 13-09-011	- Improve Demand Response reliability and utility, in order to replace quick-start fossil-fueled generation
	AB 2514 and AB 2868	- AB 2514 requires investor-owned utilities (IOUs) to procure 1325 MW of energy storage by 2024, and AB 2868 requires an additional 500 MW
	SB 338	- Utilities are to identify carbon-free alternatives to gas generation for meeting peak demand in their integrated resources plans
Industrial	Governor Brown's Clean Energy Jobs Plan	- 6,500 MW of additional capacity from combined heat and power systems by 2030
Residential / Commercial	CPUC Long-term Energy Efficiency Strategic Plan	- Set policy goals to achieve zero net energy building (ZNE) in all new residential buildings by 2020, and all new commercial buildings by 2030
	Executive Order B-18-12	- State agencies to reduce grid-based energy purchases by at least 20% by 2018 - State agencies to reduce the GHG emissions associated with the operating functions of their buildings by 20% by 2020
	AB 758	- Requires CEC to develop and implement a comprehensive energy efficiency plan for all of California's existing buildings
Agriculture	SB 1383	- 40% reduction in methane & hydrofluorocarbon emissions by 2030 - 50% reduction in black carbon emissions by 2030
Total Scoping Plan GHG Reduction	**Combined effect of policies with cross-sector impacts**	**Approximately 132 MMT GHG Abatement**

*Zero emission vehicles primarily include Plug in Hybrid Electric Vehicles, Hydrogen Fuel cell Vehicles, and Battery Electric Vehicles.

GHG Abatement Methodology

Potential measures for additional GHG abatement from each economic sector were assessed across four key criteria and weighted based on their suitability for an optimized pathway to achieve the 2030 GHG goal.

Table 3 Legend

Marginal Cost	Low	Medium	High
Abatement	Low	Medium	High
Feasibility			
Enables 2050 Target			

Table 3. GHG Abatement Pathway Selection Criteria

Sectors	Measure	Marginal Cost †	Abatement Potential ‡	Feasibility	Enables 2050 Target Δ
Transportation	Light-Duty Hydrogen Fuel-Cell Trucks				
	Light-Duty Hydrogen Fuel-Cell Autos				
	Medium-Duty Hydrogen Fuel Cell Vehicles				
	Electric Light-Duty Autos				
	Electric Light-Duty Trucks				
	Heavy-Duty Hydrogen Fuel Cell Vehicles				
	Light-Duty Plug-in Hybrid Autos				
	Light-Duty Plug-in Hybrid Trucks				
	Heavy-Duty Electric Vehicles				
	Medium-Duty Electric Vehicles				
	Medium-Duty Natural Gas Vehicles				
	Aviation Efficiency				
Electric Power	Hydrogen Pipeline Injection ¶				
	Rooftop Photovoltaic (PV)				
	Renewable Diesel Production				
	Large-Scale Renewable Generation				
	Biogas				
Industrial	Process Cooling Efficiency				
	Boiler Efficiency				
	Process Heating Efficiency				
	HVAC Efficiency				
	Lighting Efficiency				
	Machine Drive Efficiency				
Residential	Air Conditioning Efficiency				
	Clothes Washer Efficiency				
	Clothes Drying Efficiency				
	Refrigeration Efficiency				
	Dishwasher Efficiency				
	Heat Pump Water Heaters				
	Other Efficiency #				
	Air Source Heat Pumps				
	Lighting Efficiency				
	Freezer Efficiency				
Commercial	Water Heating Electrification				
	Space Heating Electrification				
	Ventilation Efficiency				
	Other Efficiency				
	Lighting Efficiency				
	Refrigeration Efficiency				

† An average Marginal Cost abatement curve represents a snapshot in time and a relative cost ranking of measures.
‡ Abatement potential represents total technical potential, rather than feasible potential.
Δ Likelihood that technology will enable California to meet its 2050 GHG emissions reduction goal.
¶ Restricted by a technical limit of 7 percent natural gas replacement.

Table 4. The Clean Power and Electrification Pathway Assumptions by Sector

	Measures	Measure Assumptions	Incremental GHG Abatement Contribution*	Full Path GHG Abatement Contribution*
Transportation	**Electric Light-Duty Autos** **Electric Light-Duty Trucks** **Light-Duty Plug-in Hybrid Autos** **Light-Duty Plug-in Hybrid Trucks** **Heavy-Duty Electric Vehicles** **Medium-Duty Electric Vehicles** **Medium-Duty Natural Gas Vehicles**	• Economic adoption alone drives 2MM of the 7 MM EVs necessary in 2030, requiring state and federal support for charging infrastructure and vehicles. • Increased EV adoption to at least 7 MM vehicles requires the extension of existing state and federal subsidies. EV growth will be driven by improved technology/lower costs, purchase incentives, charging infrastructure availability, consumer education and other measures. • Ridesharing is projected to grow by 20% through 2030. Policies that encourage the electrification of rideshare services can drive increased vehicle turnover and greater EV adoption. • On a per vehicle basis, converting an ICE vehicle to an EV has significant air quality impacts, reducing NOx emissions by 98% for light duty and medium duty vehicles, and 84% for heavy duty vehicles, in addition to having no tailpipe emissions.	15 MMT	**58 MMT**
Electric Power	**Large-Scale Renewable Generation, Energy Storage, Energy Efficiency and Distributed Solar**	• Adding up to 30 GW of large scale renewable generation combined with existing large hydro facilities can enable 80% carbon free electricity (determined through 2030 demand forecasts, less existing renewable generation contracts). • Expanding transmission and distribution infrastructure to accommodate large scale and distributed generation. Adding up to 10 GW of energy storage for grid balancing, in addition to current mandates. • Full pathway abatement includes the doubling of energy efficiency and additional distributed solar as defined in CARB's Proposed Scoping Plan.	15 MMT	**56 MMT**
Industrial	**Reduction in Refinery (Calculated outside of Pathways)**	• Increase in EV adoption reduces petroleum demand and associated refining.	4 MMT	**30 MMT**
Residential **Commercial**	**Heat Pump Water Heaters** **Air Source Heat Pumps** **Space Heating Electrification**	• Updating market costs and efficiency data, SCE calculated consumer adoption based on total cost of ownership. • Updated market data on cost plus policy driven adoption in new construction leads to an increased adoption of high efficiency space and water heaters for residential buildings, totaling over 5 million units by 2030. Commercial space and water heating is also electrified and comprises 24% of thermal load. These represent up to 30% of space and water heaters expected in California in 2030.	2 MMT	**12 MMT**
Agricultural	**(Same as CARB Proposed Scoping Plan)**			**11 MMT**
Total			36 MMT	**180 MMT**

* **Incremental GHG Abatement Contribution** represents the GHG reductions from the identified technologies to meet the incremental 36 MMT of reductions after offsets to achieve California's 2030 GHG target. This 36 MMT reduction is incentivized by the cap-and-trade market under CARB's Proposed Scoping Plan. **Full Path GHG Abatement Contribution** represents both current and expected measures in CARB's Proposed Scoping Plan and the additional identified technologies used to meet the total 2030 GHG emission reduction goal.

Results Summary

Table 5 summarizes the three pathways. All scenarios include significant new electrification, in addition to major market transformations. (More information on the alternative pathways is detailed on page 6.)

Table 5. Comparing Decarbonization Pathways

	Clean Power and Electrification	Renewable Natural Gas (RNG)	Hydrogen (H2) Pathway
Carbon-Free Electricity Delivered	80%	60%	80%
Renewable Energy Over Generation	Managed through up to 10 GW of battery storage	Used to produce synthetic methane through "power to gas"	Used for hydrogen production from steam reforming and electrolysis
Transportation: Light-Duty Passenger Vehicles (EVs)	7MM EVs 24% of LDV stock	7MM EVs 24% of LDV stock	2MM EVs 4MM H2 fuel cell vehicles 22% of LDV Stock
	~13% reduction in transportation-related refinery throughout		
Transportation: Medium-Duty (MDV) and Heavy-Duty (HDV) Vehicles (Buses and Trucks)	9% MDVs, 6% HDVs are compressed natural gas (CNG)	12% MDVs, 12% HDVs are CNG	4% HDVs are H2 7% MDVs, 6% HDVs are CNG
	15% MDVs and 6% HDVs are EVs	7% MDVs and 1% HDVs are EVs	
Space and Water Heating (Residential and Commercial buildings)	Up to 30% electrification of space and water heating end uses	42% of natural gas replaced by RNG, 7% of natural gas replaced by H2	Up to 30% electrification of space and water heating end uses
Fuels and Other End Uses	7% of natural gas replaced by RNG		7% of natural gas replaced by H2 (technical limit)
Risks	- Most feasible pathway as technology already exists - Dependent on broad adoption of electrified technologies	- Power to gas not yet commercially available - A large biogas market requires expensive imports	- Most expensive pathway - Requires significant H2 adoption outside CA - Lack of sufficient delivery infrastructure
Average Abatement Cost (180 MMT)	**$37/metric ton**	**$47/ metric ton**	**$70/metric ton**
Incremental Abatement Cost (last 36 MMT)	**$79/metric ton**	**$137/metric ton**	**$262/metric ton**

Alternative Pathway 1: Renewable Natural Gas (RNG)

The RNG pathway includes the same assumptions as the CARB Proposed Scoping Plan with a few notable differences, which include:

- Higher percentage of MDV and HDV vehicles using compressed natural gas;
- Natural gas replaced in pipeline with RNG primarily from landfill capture and conversion, including the injection of hydrogen into the pipeline; and
- Renewable power over-generation is balanced on the grid through production of synthetic methane (power to gas), a technology that is not yet commercially available.

The RNG case requires less large-scale renewable generation because a large segment of the natural gas pipeline is replaced with RNG. Consequently, the cost per ton of abatement is higher due to the cost to procure and produce RNG, which would likely require significant imports into California.

Alternative Pathway 2: Hydrogen

The hydrogen pathway builds on the CARB Proposed Scoping Plan assumptions with the following differences:

- Hydrogen Fuel Cell Vehicles have higher adoption rates across two classes (light duty vehicles, medium duty vehicles);
- Hydrogen replaces pipeline natural gas for end uses up to the technical potential of 7 percent by volume (mid-range of 5-15 percent hydrogen concentration level defined in NREL's "Blending Hydrogen into Natural Gas Pipeline Networks: A Review of Key Issues"); and
- The addition of large-scale renewable generation in the hydrogen pathway is consistent with the generation capacity called for in the Clean Power and Electrification Pathway. Excess renewable generation during peak generation periods can be used in electrolysis to produce hydrogen, helping to balance the grid and reducing the need for energy storage.

The abatement cost of the Hydrogen Pathway is the highest among all three cases, due to the need for construction of hydrogen production infrastructure not currently present in California. Additionally, hydrogen production is energy intensive and its energy storage potential is limited. Infrastructure and production costs are embedded in the cost per ton.

APPENDIX II: Additional Information and Resources

Relevant Policies

Action	Authorization	Reference
Renewables Portfolio Standard (RPS): 20% by 2010 and then 33% by 2020	SB 1078 (2002)	Sen. Bill 1078, 2001-2002 1st Ex. Sess., ch. 516, *California State Legislatur*e, Sept 12, 2002. http://www.energy.ca.gov/portfolio/documents/documents/SB1078.PDF
	SB 107 (2006)	Sen. Bill 107, 2005-2006 1st Ex. Sess., ch. 464, *California State Legislature*, September 26, 2006. http://www.energy.ca.gov/portfolio/documents/documents/sb_107_bill_20060926_chaptered.pdf
	SB X1-2 (2011)	Sen. Bill X1 2, 2010-2011 1st Ex. Sess., ch. 1, *California State Legislature*, April 12, 2011. http://www.leginfo.ca.gov/pub/11-12/bill/sen/sb_0001-0050/sbx1_2_bill_20110412_chaptered.html
Target established to reduce GHG emissions 80% below 1990 levels by 2050	Executive Order S-3-05 (2005)	California Executive Order S-3-05, June 2005. https://www.gov.ca.gov/news.php?id=1861
GHG emissions target of 1990 levels by 2020 is codified and economy-wide cap-and-trade program is created	AB 32 (2006)	Assem. Bill 32, 2005-2006 1st Ex. Sess., ch. 488, *California State Legislature*, Sept 27, 2006. http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_0001-0050/ab_32_bill_20060927_chaptered.pdf
Established RPS of 50% by 2030 and new requirements for doubling energy efficiency and wide-scale transportation electrification deployment	SB 350 (2015)	Sen. Bill 350, 2015-2016 1st Ex. Sess., ch. 547, *California State Legislature*, Oct 07, 2015. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350
GHG target of reducing emissions 40% below 1990 levels by 2030 is codified	SB 32 (2016)	Sen. Bill 32, 2015-2016 1st Ex. Sess., ch. 249, *California State Legislature*, Sept 08, 2016. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32
Cap-and-trade program extended to 2030 and new offset levels are defined	AB 398 (2017)	Assem. Bill 398, 2017-2018 1st Ex. Sess., ch. 398, *California State Legislature*, July 25, 2017. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398
CARB Proposed Scoping Plan to achieve the 2030 GHG target	CARB (2017)	AB 32 Scoping Plan, *California Air Resource Board*, last modified Jul 14, 2017, accessed Sept 13, 2017. https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm
Low Carbon Fuel Standard to encourage the production and use of cleaner low-carbon fuels	Executive Order S-1-07 (2007)	*California Air Resource Board*, last modified Sept 8, 2017, accessed Sept 21, 2017. https://www.arb.ca.gov/fuels/lcfs/lcfs.htm
Zero Emission Vehicle (ZEV) Program	CARB (1990)	*California Resource Board*, last modified August 16, 2017, accessed Sept 21, 2017. https://www.arb.ca.gov/msprog/zevprog/zevprog.htm
"The Partnership for Sustainable Communities	U.S. Department of Housing and	*Sustainable Communities*, accessed Sept 21, 2017. https://www.sustainablecommunities.gov/partnership-resources/community-planning

Action	Authorization	Reference
(PSC) works to coordinate federal housing, transportation, water, and other infrastructure investments to make neighborhoods more prosperous, allow people to live closer to jobs, save households time and money, and reduce pollution. The partnership agencies incorporate six principles of livability into federal funding programs, policies, and future legislative proposals."	Urban Development (HUD), U.S. Department of Transportation (DOT), U.S. Environmental Protection Agency (EPA) 2009	

Additional Sources

CARB Scoping Plan

The 2017 climate change scoping plan update establishes a proposed framework of action for California to achieve a 40 percent GHG emissions reduction by 2030 compared to 1990 levels. The key programs under the proposed plan are the Cap-and-Trade market, the Low Carbon Fuels standard, movement toward cleaner vehicles, increasing electricity generation from renewable sources and strategies for methane emission reduction from agriculture.
https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm

Energy Costs of GHG Emissions: National Pathway Clean Energy Study (NRDC)

NRDC's analysis shows that the United States can achieve 80 percent GHG emission reduction by 2050 from 1990 levels with only 1 percent cost increase compared with current U.S. energy cost. The key actions under the NRDC plan are: implement energy efficiency technologies to reduce energy demand by 40 percent, expand renewable energy to achieve 70 percent RPS by 2050, employ near-zero carbon electricity to displace fossil fuel usage in transportation, residential and commercial buildings and industry, and decarbonize remaining fuel use in transportation and industry.
https://www.nrdc.org/sites/default/files/americas-clean-energy-frontier-es.pdf

EV Market Trends

Electric cars sales are forecasted to surpass internal combustion engine sales by 2038 because electric cars could be cost competitive with gasoline models by 2025, battery manufacturing capacity will continue to grow, and lithium-ion cell cost will decline significantly. The global shift toward electric vehicles will create upheaval for the auto industry, will increase EV electricity consumption from 6 terawatt-hours in 2016 to 1800 terawatt-hours in 2040, and will affect the oil industry through gasoline demand reduction.
https://www.bloomberg.com/news/articles/2017-07-06/the-electric-car-revolution-is-accelerating

Electric vehicles are becoming increasingly common, with automakers indicating that about 70 EV passenger models will likely be available within five years. Key factors driving additional purchases of electric cars are that electric cars use far less energy than gasoline-powered cars, cost less to run and have lower maintenance costs. Limited variety among electric vehicles, high price premium and limited range are among the barriers that prevent people from purchasing EVs.
https://www.consumerreports.org/hybrids-evs/electric-cars-101-the-answers-to-all-your-ev-questions/

Mass-produced electric vehicles first entered the market late in 2010, with the benefit of high performance, safety, versatility and ability to conveniently charge at home at a low cost. Displacing gasoline with electricity also lowers emissions and decreases petroleum use. The challenge to consumers is to understand their own driving needs and how each vehicle option can meet their specific requirements as more options become available.
https://www.epri.com/#/pages/product/1023161/

Job Creation

The Bureau of Labor Statistics projects that solar PV installers and wind turbine service technicians will be the fastest growing occupations in the US from 2016 to 2026.
https://www.bls.gov/news.release/pdf/ecopro.pdf?utm_source=newsletter&utm_medium=email&utm_campaign=newsletter_axiosgenerate&stream=politics

According to a UC Berkeley report, 10,200 job years (one full time job for one year) have been created in the solar industry in California in the five years ending in 2014; in 2014, the average salary for these jobs was $78,000 per year plus benefits.
http://laborcenter.berkeley.edu/environmental-and-economic-benefits-of-building-solar-in-california-quality-careers-cleaner-lives/

CAISO's Senate Bill (SB) 350 report concluded that an additional 90,000 110,000 statewide jobs would be created from the 50% Renewables Portfolio Standard and also projected higher statewide gross product, real output, and state revenue across all the scenarios studied.
http://www.caiso.com/Documents/SB350Study-Volume8EconomicImpacts.pdf

The Southern California Association of Governments 2016-2040 Regional Transportation Plan is projected to create 351,000 additional jobs (in part from transportation electrification strategies).
http://scagrtpscs.net/Documents/2016/final/f2016RTPSCS.pdf

A report issued by the Union for Concerned Scientists and Greenlining Institute, reports that "California's heavy-duty EV sector is an emerging job market," and that family-supporting jobs will be available in maintenance, charging infrastructure and truck and bus manufacturing.
http://www.ucsusa.org/sites/default/files/attach/2016/10/UCS-Electric-Buses-Report.pdf

NRDC research finds that "today's automotive sector provides a powerful example of how we can simultaneously meet the nation's environmental, economic, and job-creation goals." Currently, 288,000 American workers are "building technologies that reduce pollution and improve fuel economy for today's innovative vehicles, from family sedans to long-haul tractor trailers."
https://www.nrdc.org/sites/default/files/supplying-ingenuity-clean-vehicle-technologies-report.pdf

Appendix B

Examples of Portable EV Charging Devices

Examples of portable EV charging devices

(SOURCE: Envision Solar)

(SOURCE: Freewire Technologies, Inc.)

(SOURCE: SmartFlower Solar)

Appendix C

Charging Standards and Definitions

Technical Definitions

CHAdeMo: A connector and communication protocol for vehicle DC charging initially developed in Japan during 2005-2009. It was first adopted into international standards IEC 61851-23/24 and IEC 62196-3 in 2014 and then into USA standard IEEE 2030.1.1 in 2015. Further updates to the protocol are managed by the CHAdeMO Association.[1]

Combined Charging System (or Combo/CCS) Connector: A connector that supports both AC J1772 and DC Charging and created by the Society of Automobile Engineers, which is a standards development organization for vehicle technology.[1]

Direct Current Fast Charger (DCFC): Charging at 20 kW and higher using direct current. Direct-current (DC) fast charging provides 50 to 70 miles of range per 20 minutes of charging with an electrical output ranging between 50-120 kW. A charging station that rapidly charges a car battery by connecting it directly to a higher power, direct-current source.[1]

EV Supply Equipment (EVSE): (1) the equipment that interconnects the AC electricity grid at a site to the EV. 2) Sometimes used more broadly to mean charging station, whether AC or DC, but not including the make-ready infrastructure or other charging infrastructure. May include multiple connectors (called multi-port) to charge several EVs or to serve EVs with different types of standard connectors (e.g. SAE Combo and CHAdeMO). .[1]

EVSE Charging Port: Plug or connector on an EVSE capable of plugging into a vehicle for charging it. One EVSE may have multiple charging ports.

Level 1 (L1) Charging: AC Level 1 provides 1 to 5 miles of range per 1 hour of charging using 120VAC electrical service.[1]

Level 2 (L2) Charging: AC Level 2 provides 10 to 20 miles of range per 1 hour of charging using 240VAC or 208VAC electrical service.[1] L2 charging is faster than L1 because it delivers a higher power level to the battery through the EVSE.

Make Ready: Service connection and supply infrastructure to support EV charging comprised of the electrical infrastructure from the distribution circuit to the stub of the EVSE. It can include equipment on the utility-side (e.g., transformer) and customer-side (e.g., electrical panel, conduit, and wiring) of the meter.[1]

Site: Location at which charging infrastructure is installed.[1]

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[1] Definitions are taken from D.18-05-040.

Transportation Electrification: The use of electricity from an external source to fuel all, or part, of the energy needs of vehicles, vessels, trains, boats, or other mobility equipment.[1]

Vehicle Charge Port: Generally, refers to the location where the EVSE Charging Port connector attaches to the vehicle.

Appendix D

Witness Qualifications

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY

OF KATHLEEN SLOAN MOODY

Q. Please state your name and business address for the record.

A. My name is Kathleen Sloan Moody, and my business address is 2244 Walnut Grove Avenue, Rosemead, California 91770.

Q. Briefly describe your present responsibilities at the Southern California Edison Company.

A. I am Director of Transportation Electrification at Southern California Edison. I lead an organization for responsible for the implementation of Transportation Electrification programs, strategies, and external engagement. I have held this position since July 2018.

Q. Briefly describe your educational and professional background.

A. I hold a Masters in Regulatory Economics and a Bachelor's in Business Administration from New Mexico State University. Prior to my previous role, I worked in Strategic Planning at Edison International where I developed innovative business opportunities for the company in areas including microgrids and transportation electrification. Prior to that, I led a regulatory and legislative policy team at SCE that worked on procurement of renewable, alternative, and conventional generation. Prior to that role, I was a Public Affairs manager at First Solar responsible for developing global policy positions for the company. Early in my career, I took on increasing responsibilities at SCE, focusing on policy, strategic, and analytical issues relating to clean energy. I have previously testified before the California Public Utilities Commission.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of Exhibit SCE-01, entitled *Testimony of Southern California Edison Company in Support of its Application For Approval of Electric Vehicle Charging at Schools, State Parks and Beaches (AB 1082 & 1083)*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY

OF ERICA BOWMAN

Q. Please state your name and business address for the record.

A. My name is Erica Bowman, and my business address is 2244 Walnut Grove Avenue, Rosemead, California 91770.

Q. Briefly describe your present responsibilities at the Southern California Edison Company.

A. I am a Director of Environmental Strategy and Analytics at Southern California Edison. My current responsibilities include managing the Environmental Strategy and Resource Planning functions within SCE's Strategy, Integrated Planning and Performance department. I have held this position since July 21, 2017.

Q. Briefly describe your educational and professional background.

A. I received a Bachelor of Science and Engineering degree in Operations Research and Financial Engineering from Princeton University and a Master of Science degree in Operations Research from Northeastern University. Prior to my position at SCE, I was the Chief Economist at the American Petroleum Institute where I managed all commodity market analysis and was API's primary spokesperson on issues related to economic development and energy market movements, and their associated impacts. I have not previously testified before the California Public Utilities Commission.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of Exhibit SCE-01, entitled *Testimony of Southern California Edison Company in Support of its Application For Approval of Electric Vehicle Charging at Schools, State Parks and Beaches (AB 1082 & 1083)*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY
QUALIFICATIONS AND PREPARED TESTIMONY
OF ERIC SEILO

Q. Please state your name and business address for the record.

A. My name is Eric Seilo, and my business address is 8631 Rush Street, Rosemead, California 91770.

Q. Briefly describe your present responsibilities at the Southern California Edison Company.

A. I am currently a Senior Advisor of Environmental Strategy and Analytics at Southern California Edison. My responsibilities are centered on advancing the utility's role in accelerating transportation electrification through developing charging infrastructure deployment strategies, designing programs to incentivize greater EV adoption, and influencing emerging state regulatory policies to accelerate TE. I have held this position since January 2018.

Q. Briefly describe your educational and professional background.

A. I earned a Bachelor's degree in International Relations from the University of Southern California and a Master of Arts in Economics, Energy and Environmental Policy from Johns Hopkins School of Advanced International Studies (SAIS). I have worked on SCE's TE strategy and program design since 2013 including development of SCE's Charge Ready Pilot Program, Clean Fuel Reward Program, and SB 350 Transportation Electrification Portfolio projects. Additionally, I have worked closely with leading research institutions and organizations as a utility EV subject-matter expert and contributor on several industry research reports.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor the portions of Exhibit SCE-01, entitled *Testimony of Southern California Edison Company in Support of its Application For Approval of Electric Vehicle Charging at Schools, State Parks and Beaches (AB 1082 & 1083)*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY
QUALIFICATIONS AND PREPARED TESTIMONY
OF GRANT LITTMAN

Q. Please state your name and business address for the record.

A. My name is Grant Littman, and my business address is 2244 Walnut Grove Avenue, Rosemead, California 91770.

Q. Briefly describe your present responsibilities at the Southern California Edison Company.

A. I am a Principal Manager of Marketing and Digital at Southern California Edison. I lead a team responsible for SCE's marketing communications and the digital customer experience associated with Customer Service programs, rates, and services. I have held this position since March 2018.

Q. Briefly describe your educational and professional background.

A. I hold a Bachelor of Science in Business Administration degree from the University of Southern California. I have worked at SCE for approximately 11 years in Customer Service and Corporate Communications. Prior to my present position, I was a Senior Manager of Digital. In that position, I was responsible for a team that oversaw digital strategy, content management, digital products, and digital analytics. From 2010-2011, I was the Senior Manager of SCE's Corporate Communications Web team responsible for the strategic planning, governance and day-to-day operations of the three core Edison International websites: edison.com, sce.com, and the enterprise intranet. Prior to that, I joined SCE in 2007 as the Senior E-Channel Manager, responsible for establishing a new functional area within the Customer Experience Management department focused on the development of SCE's digital self-service channels. Prior to joining SCE, I worked at Epson America, Inc. for 10 years in a variety of marketing and product management positions, ultimately leading that company's North America direct-to-consumer e-commerce business. I have not previously testified before the California Public Utilities Commission.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor the portions of Exhibit SCE-01, entitled *Testimony of Southern California Edison Company in Support of its Application For*

Approval of Electric Vehicle Charging at Schools, State Parks and Beaches (AB 1082 & 1083), as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY

OF MATTHEW D. SHERIFF

Q. Please state your name and business address for the record.

A. My name is Matthew David Sheriff, and my business address is 2244 Walnut Grove Avenue, Rosemead, California 91770.

Q. Briefly describe your present responsibilities at the Southern California Edison Company (SCE).

A. I am currently Senior Advisor in SCE's CPUC Revenue Requirements and Tariffs Department. As such, I am primarily responsible for preparation of SCE's Cost Recovery showing and forecasting SCE's revenue requirements and system average rate.

Q. Briefly describe your educational and professional background.

A. I graduated from the University of Maryland Baltimore County in May of 1995 with a Bachelors of Arts Degree in Political Science. For the next seven years I worked at several venture-backed new media startups in marketing and business development roles. In August of 2004 I earned a Master of Business Administration (MBA) degree from the University of Southern California with an emphasis on Corporate Finance. After graduation, I worked for Raytheon Inc. as a senior financial analyst responsible for balance sheet and cash flow forecasting. In April of 2007, I joined Southern California Edison Company as Senior Financial Analyst in the Financial Planning and Analysis group of the Treasurer's department. In this role as a financial subject matter expert, I prepared cost-effectiveness analysis in support of applications before the CPUC, including SmartConnect®, SONGS High Pressure Turbine and the sale of SCE's interest in Four Corners. I was promoted to senior project manager while in this department. I started in my current position in January of 2014. I have previously testified before the California Public Utilities Commission.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of Exhibit SCE-01, entitled *Testimony of Southern California Edison Company in Support of its Application For*

Approval of Electric Vehicle Charging at Schools, State Parks and Beaches (AB 1082 & 1083), as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

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A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.